RTD ENGINEERING DIVISION	☐ Policy Directive ☐ Procedural Directive ■ Guideline	**Number:** 5
Title: **Building in Close Proximity to Existing Commuter Rail Tracks**	**Supersedes:** Informal guidance	

Purpose and Scope:

The purpose of this document is to list some of the major issues of building and operating next to an active commuter rail track. It is not to replace the detailed documentation required to build adjacent to RTD Commuter Rail, but rather to inform about the more prevalent questions related to building in close proximity of RTD trackways. These questions often relate to utility crossings, safety, providing adequate sight distance for safe operations, development adjacent to an active transit way, and excavating in a manner that protects the integrity of the trackway. The RTD Engineering Division has responded to enquiries from development groups and cities, attended meetings, and reviewed plans regarding proposed developments adjacent to RTD's commuter rail system. While most reviews, conversations, and emails touch upon some of the issues, others are not addressed. RTD has a design criteria document that governs the design of its Commuter Rail System. Electronic copies of the criteria will be provided on request. Contact Engineering@RTD-Denver.com for questions related to this document.

Additionally, for construction of utilities within the RTD right-of-way, information is available on the RTD web site ~~entitled "Utility Construction in the RTD District"~~ at http://www.rtd-denver.com/UtilityConstruction.shtml. Contact Engineering at 303-299-2811.

is this a general engineering number? or just for utilities?

Implementation:

Track and systems planning, design, construction, and operation require precautions that developers, design professionals, contractors, and other agencies need to understand, and be aware as to the necessity to adhere to the requirements and recommendations provided herein and as referred to in RTD's design criteria.

Planning and Design

General Considerations

1. RTD does not allow ~~for~~ any access or construction to take place within its right of way without ~~the~~ written approval from RTD. ~~Other~~ elements outside of the RTD right of way may impact safe operations of the transit system if not taken into consideration in the development of the site. Sight distance is extremely important for the train operator and for the safety of the general public.

Line of Sight

2. Trains need a significant distance to stop, once brakes are applied. A train traveling at 20 miles per hour (mph) requires approximately 260 feet to come to a complete stop in an emergency situation. Higher speeds require significant additional time and distances. Trains operate up to 79 mph in certain areas of the trackway. In these locations, it takes a train almost 4,000 feet to stop in an emergency situation which includes operator reaction time. Having a clear line of sight is therefore extremely important. To obtain a clear line of sight:
    a. Avoid creating visual obstructions for the train driver.
    b. Keep landscaping below 12-18-inches. where? within certain distance of track?
    c. Bridge piers or other structural elements within 25 feet of centerline of track require additional protection.
    d. Minimize locations where people can gain access to the trackway or accidently fall onto the track.
    e. Encourage pedestrian crossing movements to be at designated gated intersections.

General Information [combine with #1]

3. Maintaining the safety of the system is required at all times. It is also important to create an environment which benefits both the public and operations of the transit system. Designing elements in and around the trackway should therefore take this into consideration.

    a. In emergency situations, the train may need to stop anywhere on the track, open its doors, and let out people adjacent to the trackway.
    b. Minimize trip hazards at crossing locations.
    c. Avoid creating restricted areas where people could get pinned between the train and an obstruction. A minimum setback of 10 feet from the center line of track is strongly recommended for all elements placed adjacent to the trackway.
    d. Station platforms and sidewalks adjacent to platforms, where waiting areas and platform areas merge, shall have a minimum width of 16 to 18 feet for side platforms and 30 feet for center platforms to accommodate safe waiting areas for passengers, and to allow for free flow of pedestrian movement. Each location should be evaluated depending on projected use of the area. Additional requirements are contained in the Commuter Rail Design Criteria.

e. Snow removal shall be considered in the design of facilities so as to not impede pedestrian flow, vehicular traffic and train operations.
f. The train system generates vibration and noise. Owners of adjacent properties should take these factors into account.

Dynamic Envelope of the Train

4. Train operations also require the integrity of the trackway be maintained at all times. The trackway and the catenary system (the overhead electrical system) needs to have a clear pathway in which to operate. The catenary system may sway. The dynamic envelope of the train generally requires 5 feet 8 inches clear horizontally from centerline of track, in order not to hit an obstruction in the path of the train. Colorado Public Utilities Commission (PUC) requires a minimum horizontal clearance of 8'-6" that allows for an emergency walkway. Vertical clearance of 23'-6" is required for overhead bridges and other structures. At locations where the train follows a curve, additional clearance is required. Determining the dynamic envelope in these instances will require additional analysis. The trackway itself needs a stable foundation on which to be placed so as not to shift and therefore have the potential for the train to derail or leave the trackway. Therefore, no obstruction is permitted within the dynamic envelope of the train.

Landscaping

5. It is strongly suggested that trees planted adjacent to RTD right of way be ~~in places such~~ that the predicted tree canopies are ~~situated~~ beyond 30-feet of the centerline of the track. It reduces the potential for the tree roots to undermine the trackway. It also reduces the danger from the need to prune or replace the tree, and keeps people and equipment needed to perform these activities from coming in contact with the overhead electrical system.

Excavation

6. Excavation within the proximity of RTD tracks which encroaches into the supporting subgrade as described in the attached Figure 1, General Shoring Requirements, shall comply with the requirements of BNSF/UPRR Guidelines for Temporary Shoring. Live load for design of shoring adjacent to Commuter Rail tracks shall correspond to the attached RTD Commuter Rail Loading Diagram from the Commuter Rail Design Criteria. Contractor shall submit shoring plans and design calculations, stamped and signed by a Professional Engineer registered in the State of Colorado, to RTD for review and acceptance. The submittal shall include a stamped and signed cover letter stating that the shoring design complies with the BNSF/UPRR Guidelines for Temporary Shoring. Shoring design and plans shall be submitted no later than 60 days prior to planned start

of construction. Construction adjacent to the tracks shall not begin prior to RTD acceptance of the shoring design.

http://www.rtd-denver.com/UtilityConstruction.shtml

Utilities

7. a. RTD will review all proposed utilities across rail tracks. Please see http://www.rtd-denver.com/Reports.shtml ~~under the section "RTD Utility Agreements" for the process and requirements.~~

8. b. Open cutting for utility installation is not allowed across the Commuter Rail tracks because of the potential to undermine the track as well as creating an unsafe operating condition.

9. c. RTD cannot make any assurances to the horizontal location and cannot confirm depth to top or bottom of RTD duct banks between RTD tracks due to signal interference from track rails. The contractor shall identify the horizontal location and vertical depth of RTD underground electric and communication ducts without compromising the integrity of the RTD tracks or dynamic envelope. This may be accomplished by various means of locating the top and bottom of the RTD ducts as approved by RTD Engineering.

Drainage

10. a Existing contributory drainage areas and flows shall be maintained such that drainage to and /or across RTD Commuter Rail tracks is equal to or less that historic conditions.

11. b The proposed development shall be designed to safely collect and convey historic flows from RTD's trackways and shall not construct obstructions that can divert additional flows into the trackway or create back water conditions for the trackway.

12. c The proposed development shall not discharge storm water directly into the trackway. All onsite drainage shall discharge into an approved storm drain system.

13. d The proposed development shall not discharge storm water drainage from adjacent property due to construction onto or across the tracks. Ballasted track in particular can lose its strength, if the ballast gets clogged with dirt.

14. e The proposed underground appurtenances shall not interfere with the continuity of the RTD underdrain system. All onsite dewatering systems shall be designed such that they do not surcharge the RTD underdrain system.

Electrical System

15. Commuter Rail vehicles operate on an alternating current (AC) electrical system. Bridges which cross over the trackway, which are less than 6 feet from the soffit to the
a pantograph and live wire, shall have flash plates installed on the bridge soffit due to the potential of arcing from the pantograph.

~~16.~~ Operation of the train may create electro-magnetic interference (EMI) to the surrounding area. Sensitive electronic equipment should therefore not be placed near the trackway.
b EMI generating ~~type of~~ equipment may also interfere with the train control system and therefore should be avoided near the train's signal control system which is normally part of the trackway.

~~17.~~ All metallic objects that are within 15 feet of the centerline of the near rail shall be grounded. Metallic objects should be connected to the ground grid if available or else a
c ground rod shall be driven. A minimal ground resistance test of 25 Ohms or less shall be achieved.

Fencing & Barriers

18. Right-of-Way (ROW) fencing and/or barriers shall be provided along the entire Commuter Rail alignment. The fencing and barriers shall be designed to address the following:
    a. Act as a safety barrier to prevent vehicles, trucks, and other highway/roadway users from accidentally entering the CRT envelope;
    b. Shall be of sufficient height to prevent trespass;
    c. Shall be designed to prevent debris and roadway snow removal activity (snow plows throwing slush, ice, and other debris) from entering rail envelope and transit station areas; and
    d. Shall incorporate safety considerations on elevated sections with respect to fall protection and providing adequate space for maintenance-of-way workers.
    e. The exact height and type of fence will vary on the location and shall conform to Section 14 of the Commuter Rail Design Criteria. The final design shall be approved by the RTD System Safety Project Manager.
    f. Fences that are within 15 feet of the centerline of the near rail and are tested to exceed a ground resistance of 25 ohms shall be grounded conforming to Article 250 of the National Electric Code. The fence is to be connected to a ground grid if available, otherwise a ground shall be installed at a maximum of every 500 feet

rod (?)

and driven at least 7-1/2 feet into the ground. The rod shall be connected to a fence with a maximum AWG No. 8 stranded copper wire.

g. The fence shall be constructed in accordance with CDOT standard plans. Adjacent landowners may propose alternate fencing styles meeting the above Criteria, provided they repair and maintain them as needed.

General Considerations [move to #1]

19. Coordinate design and construction with RTD Operations, Engineering and Maintenance-of-Way, and Denver Transit Operators. Early discussions and submittals are encouraged. Final Construction Plans need to be submitted a minimum of thirty days prior to construction. Complex projects may take longer to review.

General Considerations [move to #1]

20. Any permanent changes proposed on RTD Property, Easements or Infrastructure shall go through the RTD Safety Certification Process.

Design Reviews

Plans and design documents that affect RTD need to be submitted to RTD for review and approval. A list of design documents will be provided by RTD to the developer upon request. The Grade Separation Guidelines from UPRR/BNSF is considered to be part of the design guidelines and criteria and shall be incorporated as appropriate. RTD Engineering shall review the plans, and work with developers, design professionals, and other agencies to resolve comments and concerns.

Construction Planning

1. Construction shall be planned so as ~~to~~ not disrupt rail and bus service. Check http://www.rtd-denver.com/Schedules.shtml for schedules.
2. Disruptions of rail service will only be considered at the request of other Local Governments, CDOT, Railroads, and utilities, for projects that serve a public purpose.
3. When there is an outage to the rail service, RTD provides bus bridges to transport passengers on buses. These activities need to be coordinated well in advance. All costs for alternate means of transportation provided will be paid for by the Agency or entity making the request.
4. All costs for changes to the RTD System and disruption to rail and bus services will be paid for by the Agency or entity making the request.

5. Any construction that impacts RTD properties or easements shall comply with RTD FasTracks Construction Safety guidelines.
6. Contractor shall plan on periodic meetings with RTD Operating Divisions.
7. If Driver Relief Kiosks need to be taken out of service, alternate arrangements will be made to satisfy RTD Operating Divisions and ~~DTO~~. Denver Transit Operators (DTO), RTD's concessionaire.

RTD Rail and Other Properties

1. Developers need to plan their projects starting with the assumption that RTD Property is not available for their projects.
2. ~~The~~ RTD does not grant easements over its property. ? This doesn't seem totally accurate.
3. Revocable License Agreements for utility connections across the track may be considered, if there is no other practical and feasible option. RTD Property may have been acquired with Federal Transit Administration (FTA) funding; the FTA may need to concur on any property agreements.

across tracks, perhaps?

Rail Right-of-Way Access

This shall apply to construction impacting RTD rail and/or within 25 feet of RTD tracks.

The permission to work within RTD properties, and easements is granted by RTD's Real Property Division. This Division runs the process internally to coordinate the response back. Please contact the Real Property Division early on in the process. RTD may deny these requests. Contact: Susan.Altes@RTD-Denver.com 303-299-2440.

After permission has been granted to work within RTD properties and easements, contractor shall be responsible for obtaining an access the R W Group ~~a permit from~~ RTD Commuter Rail right-of-way ~~for an access permit~~ to perform work. RTD has a concessionaire agreement with Denver Transit Operators to operate a portion of its Commuter Rail network. See attached map. The operator of North Metro remains to be determined.

The RTD Commuter Rail right of way access request permit can be coordinated through Denver Transit Operators Client Services Specialist/Track Usage Coordinator at track.usage@rtdcrail.com~~.~~ and at 720-460-5803. All personnel who shall be within 25-feet of the track shall undergo On Track Safety Training, prior to receiving the access permit Contractor is responsible for providing and maintaining a written safety program conforming to the requirements of the RTD Construction Safety Manual. RTD's on-track safety training

is required for all personnel performing work in the vicinity of light rail, commuter rail and freight rail systems. Contact Safety Compliance Officer at 303-299-2077 to schedule the on-track safety training.

Non-Rail Building and Grounds Access Policy

An RTD Building and Grounds Access Permit is required prior to any non-RTD party commencing modifications to any non-rail RTD property, buildings or grounds. Please see http://www.rtd-denver.com/Reports.shtml for information about applying for this permit. This applies to park-n-rides and other properties adjacent to rail.

Construction Inspections

Contractor must contact RTD Engineering a minimum of 48 hours prior to start of construction to schedule a pre-construction meeting and arrange for on-site inspection during construction.

Construction Contracts

Based on the nature of proposed construction, RTD Risk Management may review construction contract coverages and limits, and require that RTD be named as an additional insured on policies.

Approval

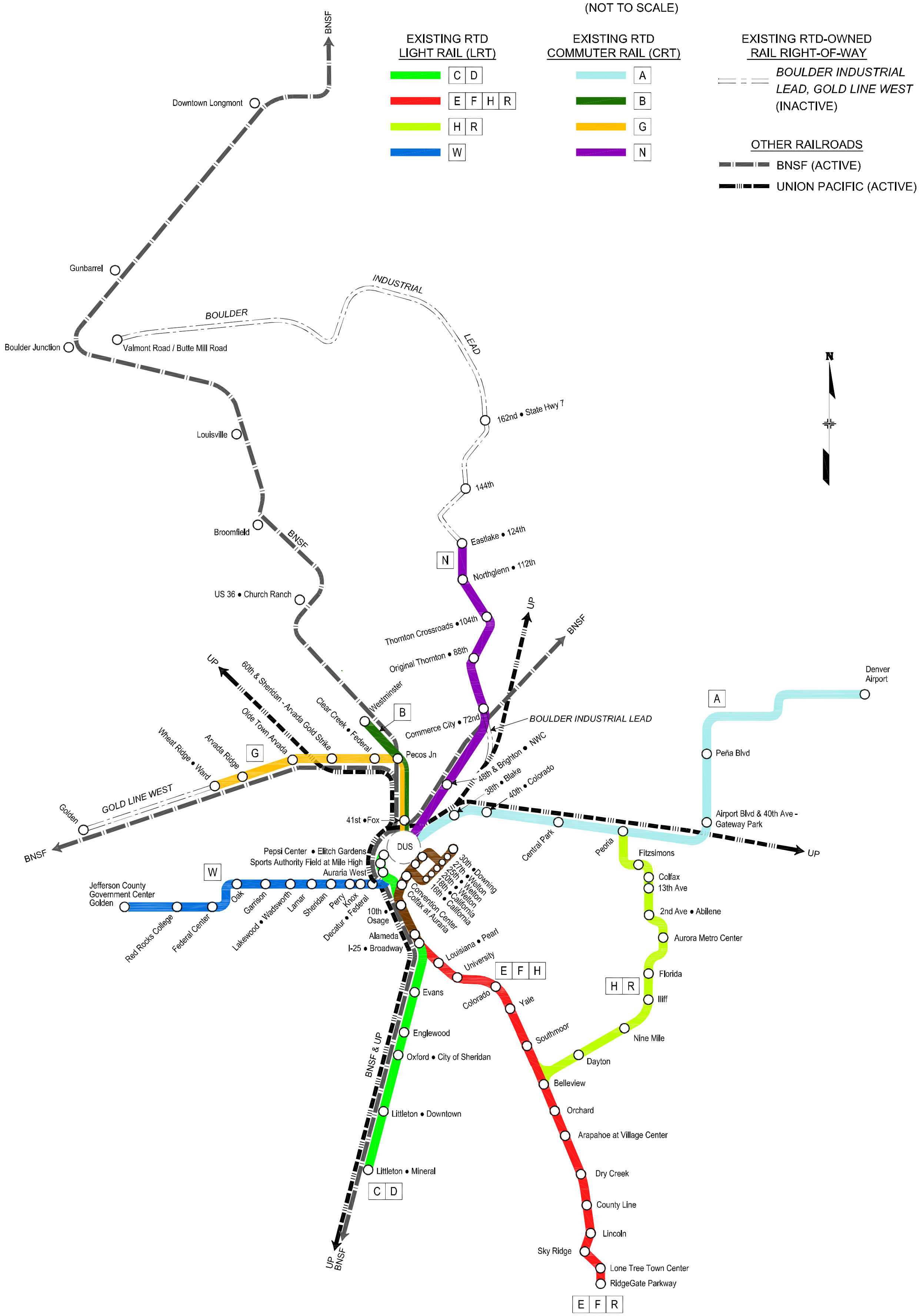
Revision Level	Summary	Approved By	Signature	Date
0	Initial Baseline Issue	Jyotsna Vishwakarma, P.E. Senior Manager Engineering / Chief Engineer for RTD		
0	Initial Baseline Issue	Ron Benson, P.E. Chief Engineer for DTO		

0	Initial Baseline Issue	Terry Emmons, Assistant General Manager, Rail Operations		
0	Initial Baseline Issue	Michael Meader, Assistant General Manager Safety, Security & Facilities		
0	Initial Baseline Issue	Henry J. Stopplecamp, P.E. Assistant General Manager, Capital Programs		

RAIL MAP

RTD AND OTHER RAIL CORRIDORS

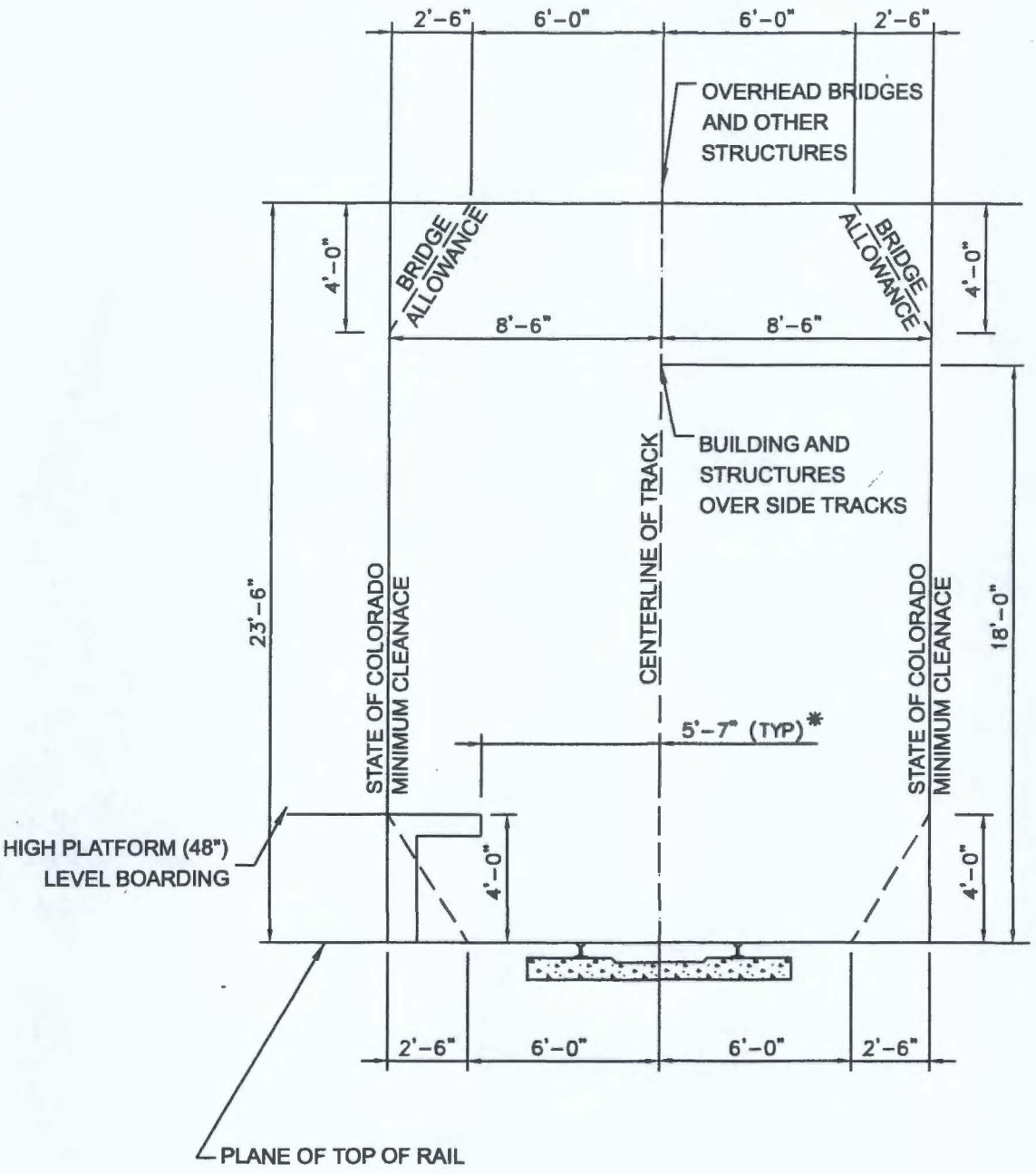
(NOT TO SCALE)



UPDATED:
2/2017

P:\BThye\RTD utility-permit website\RAIL MAP rev 02-06-17.dwg, Model, 2/14/2017 7:47:17 AM, 1:1.1

SEE SECTION 9 TRACTION ELECTRIFICATION FOR OCS AND WIRE CLEARANCES
THIS DIAGRAM IS NOT TO BE USED TO DETERMINE OVERHEAD ELECTRIFICATION CLEARANCES



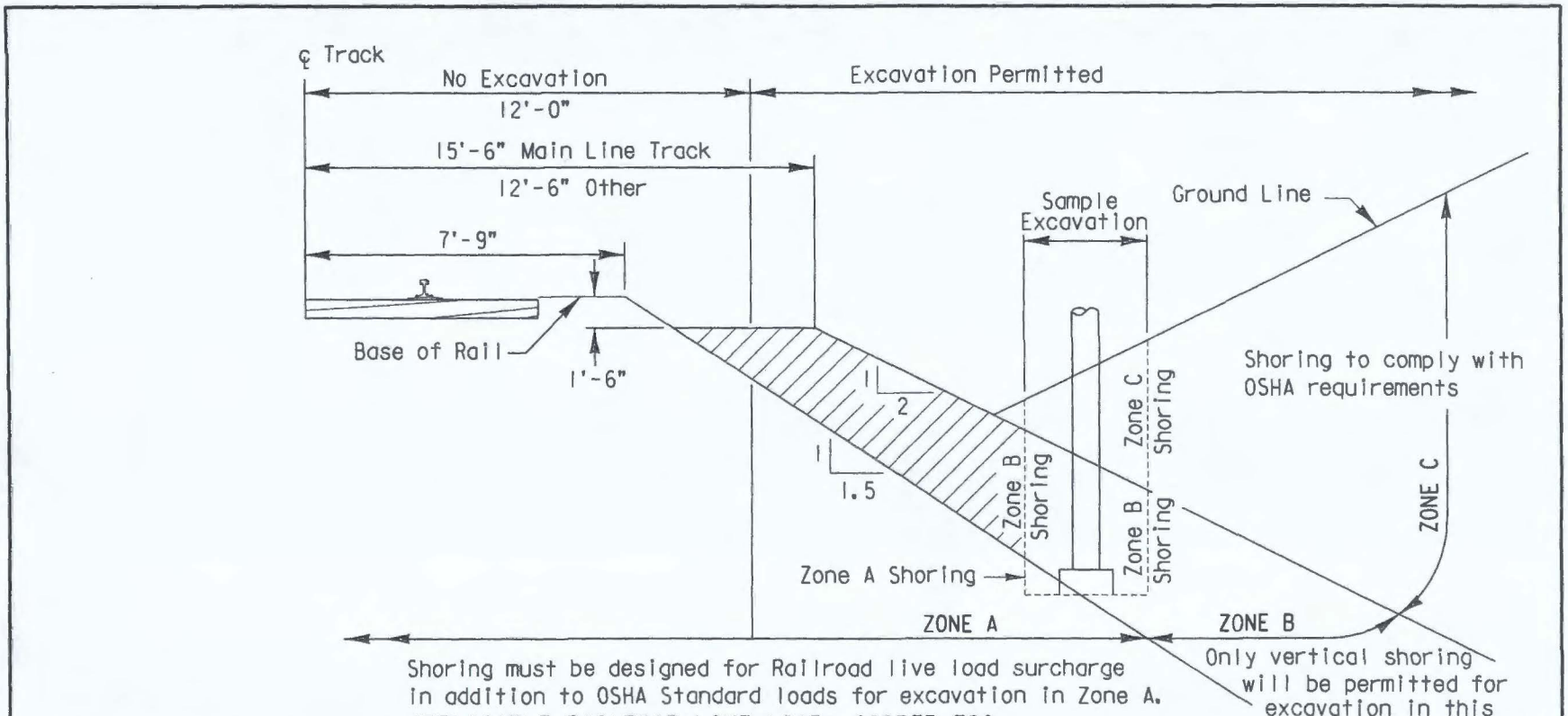
* MUST MEET ADA STANDARDS

RTD
1560 BROADWAY, SUITE 700
DENVER, COLORADO 80202
(303) 299-6990

DESIGN CRITERIA

TITLE: TRACK
MINIMUM TRACKWAY CLEARANCES

FIGURE: 4.4



GENERAL NOTES:

All dimensions are measured perpendicular to ℄ of track.

Prior to commencing any work, the contractor shall submit for approval by the Railroad detailed plans indicating the nature and extent of the track protection shoring proposed. The contractor shall install the temporary shoring system per the approved plans. Design of the temporary shoring system to comply with **GUIDELINES FOR TEMPORARY SHORING.**

For excavations which encroach into zone A or B, shoring plans shall be accompanied by design calculations. Plans and calculations must be signed and stamped by a Professional Engineer registered in the state where the work will be performed.

GENERAL EXCAVATION ZONES

SCALE: (NOT TO SCALE)

REVISIONS		
DATE	LTR.	DESCRIPTION
8/03	1	FORMERLY UPRR C.E. 106913
/		
/		
/		
/		
/		

DESIGN BY: PGP | DRAWN BY: JFS | CHECKED BY: AA

APPROVED:

K.H. Jennison
BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN

9-1-04
UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN

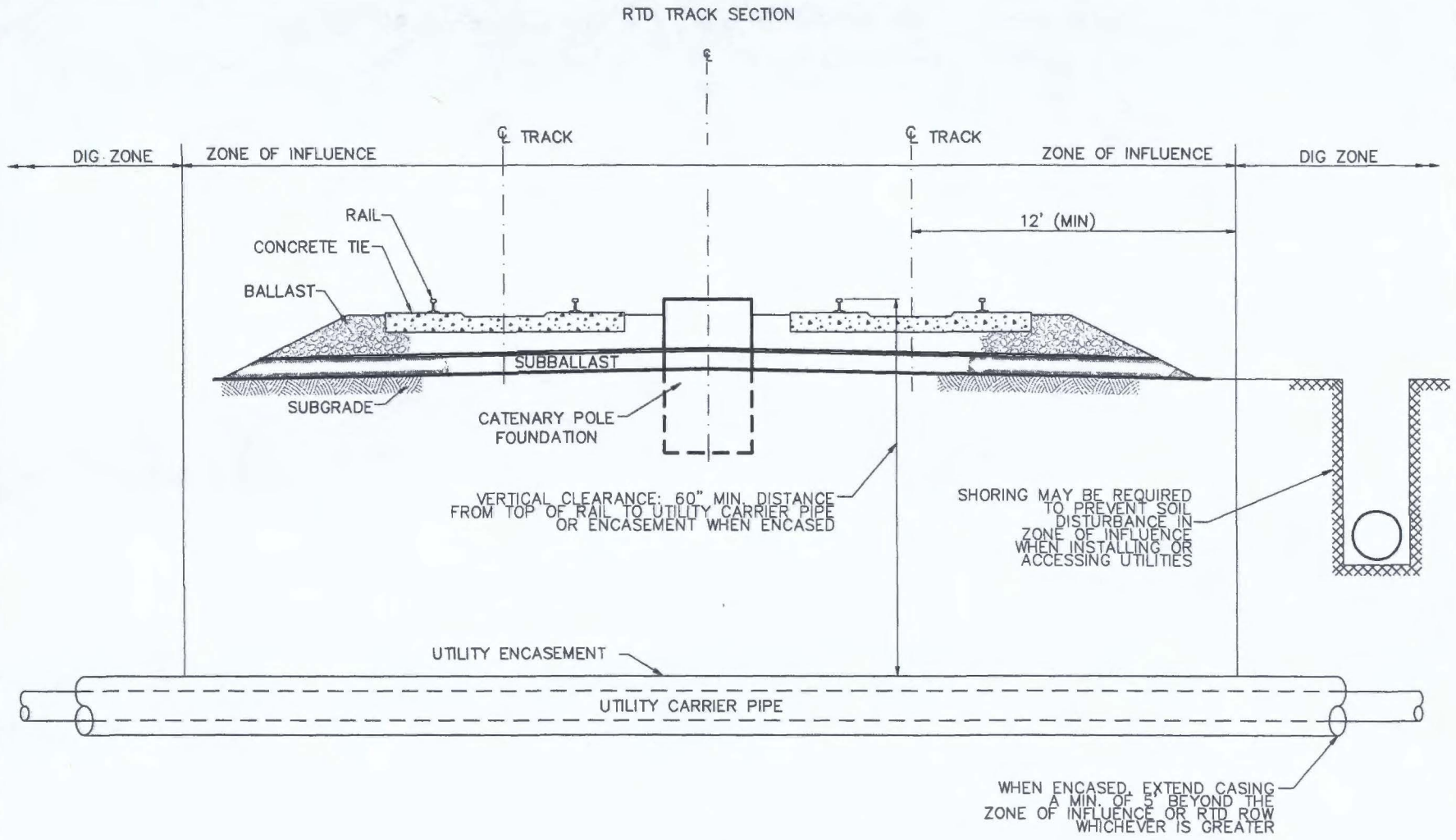
BRIDGE STANDARDS

GENERAL SHORING REQUIREMENTS

FILE OWNER: UPRR | DATE: 5-8-03
PLAN NO.: 710000 | SHEET: 1 OF 1

PLOTTED: $$$$DATE$$$ &TIME

Figure 1



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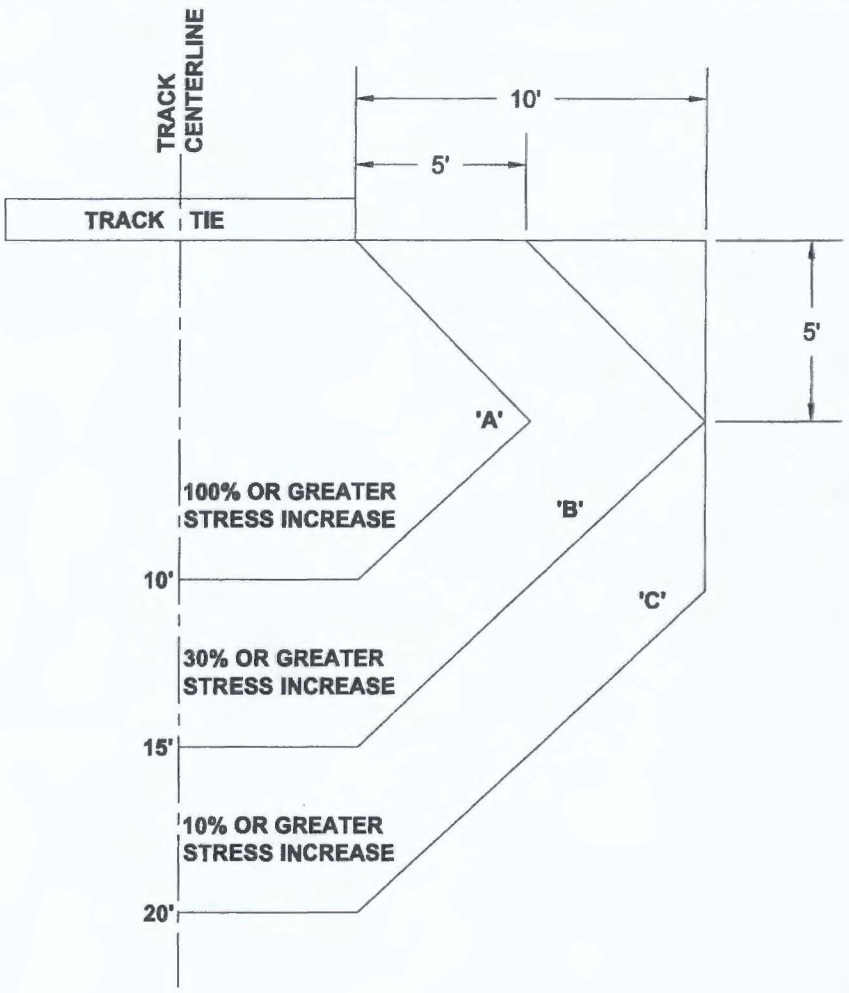
1600 BLAKE STREET
DENVER, COLORADO 80202
(303) 628-9000

COMMUTER RAIL
DESIGN CRITERIA

TITLE: UTILITY DETAIL

FIGURE: 3.1



Stress Influence Diagram

The 'Stress Influence' diagram is to be used to calculate the increase in stress on a pipe or utility facility installed in the ground under a trackway. The diagram shows three areas and the corresponding stress increase for each area. The percent of stress increase is to be added to the normal stress loads on the same pipe within the same depth without the track above it. Existing pipes that will fall under new track shall be analyzed using this diagram and calculations shall be provided to assure they will meet the added stress influence of the track.

- A pipe located 10' or less below the track tie and within area 'A' shall be designed for 100% or greater increase in stress.
- A pipe located 10' to 15' below the track tie and within area 'B' shall be designed for a 30% increase in stress.
- A pipe located 15' to 20' below the track tie and within area 'C' shall be designed from a 10% increase in stress.

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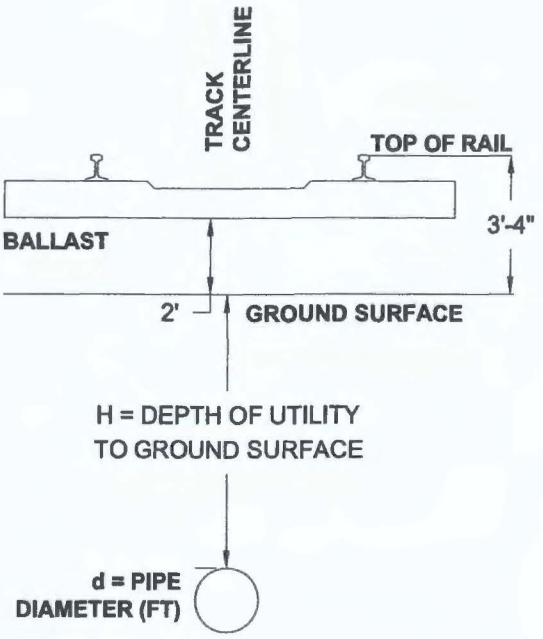
COMMUTER RAIL DESIGN CRITERIA

TITLE: STRESS INFLUENCE DIAGRAM

FIGURE: 3.2



Surface influence potential for clay soil (phi = 20 degrees)

For an overall 5% decrease in soil density due to collapse use:

H=(5*d)-1

The depth to the pipe (h) is below the track ballast assumed to be 2 feet.

Influence of Utility Collapse Diagram and Formula

The 'Influence of Utility Collapse' diagram and formula shall be used to calculate the minimum depth H (ft) a pipe of a diameter d (ft) must be located below the finished ground surface to avoid potential collapse due to loads. This formula applies to non-pressurized and/or empty pipes including abandoned, retired, decommissioned, and active lines that are not at full-flow (ie. communication ducts). This diagram and formula should be used for the following two purposes.

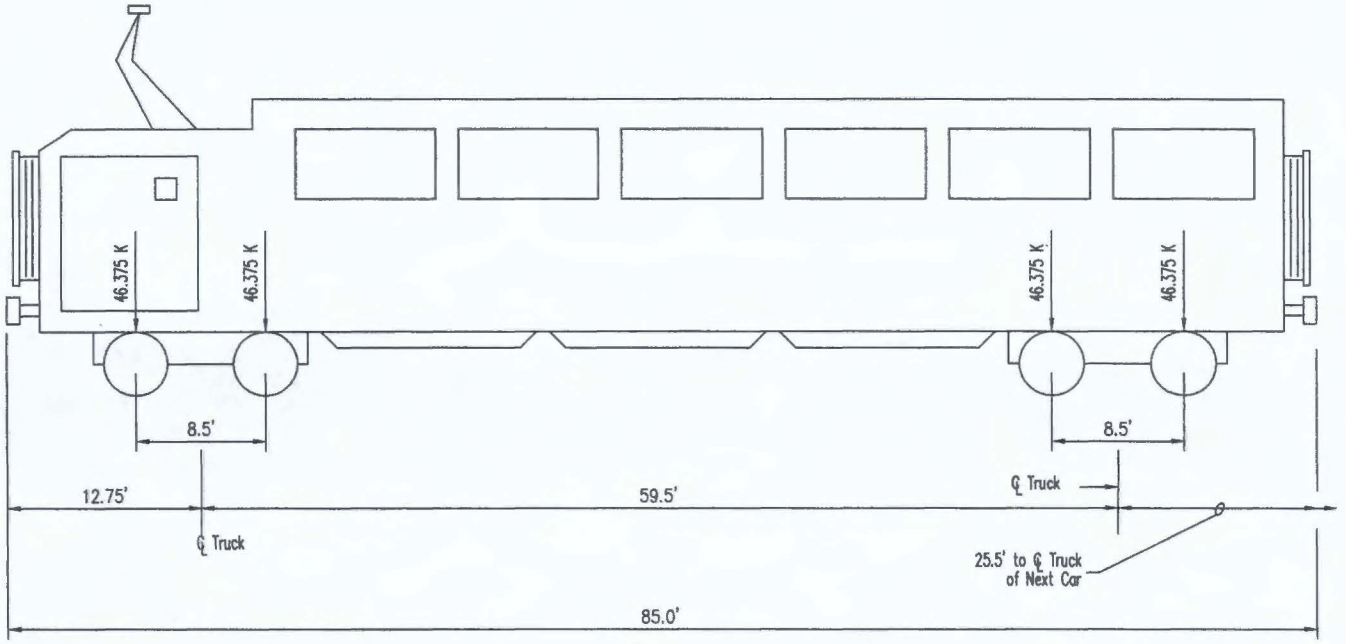
- Abandoned and Retired lines: Influence of Utility Collapse calculations will indicate the need to flow fill or remove the pipe. Any abandoned or retired pipe that does not meet the minimum depth H shall be removed or flow filled per RTD specifications.
- Active (new and existing) and Decommissioned lines: Influence of Utility Collapse calculations will indicate if the pipe installation meets the minimum depth H. Any active or decommissioned pipe that does not meet the minimum depth H shall be relocated to or below the minimum depth H or shall be replaced with a new pipe of an appropriate diameter d to prevent future collapse from causing damage to the rail line.

When a duct bank of pipes, conduits or ducts are buried beneath the tracks the equivalent diameter of all the pipes, conduits or ducts shall be used as the diameter d.

Example:
A 12" diameter pipe shall be buried at least H (ft) where:
H = [(5xd) - 1'] = 4' below finished ground surface
Or buried to a depth of 4'+ 3'4" = 7'4" below top of rail

RTD

COMMUTER RAIL DESIGN CRITERIA	TITLE:	INFLUENCE OF UTILITY COLLAPSE
	FIGURE:	3.3



NOTES:

1. TOTAL CRUSH LOAD 185.5 KIPS/CAR.
2. ONE CAR SHOWN, EIGHT CARS OPERATING MAXIMUM.

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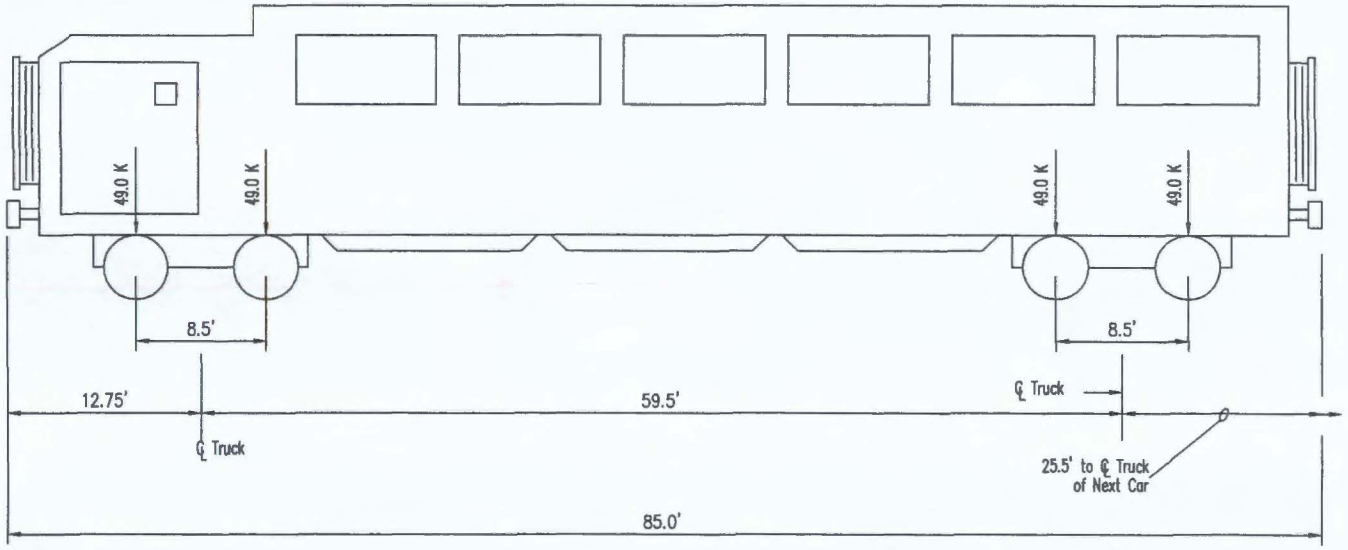
COMMUTER RAIL
DESIGN CRITERIA

TITLE: CRT LOADING DIAGRAM
CORRIDOR VEHICLE
ELECTRIC MULTIPLE UNIT (EMU)

FIGURE: 6.2



NOTES:

1. TOTAL CRUSH LOAD 196 KIPS/CAR.
2. ONE CAR SHOWN, EIGHT CARS OPERATING MAXIMUM.

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COMMUTER RAIL
DESIGN CRITERIA

TITLE: CRT LOADING DIAGRAM
CORRIDOR VEHICLE
DIESEL MULTIPLE UNIT (DMU)

FIGURE: 6.1