California High-Speed Train Project

TECHNICAL MEMORANDUM

Rolling Stock and Vehicle Intrusion Protection for High-Speed Rail and Adjacent Transportation Systems TM 2.1.7

Prepared by:	*Signed document on file* Dominique Rulens	13 Oct 08 Date
Checked by:	*Signed document on file* John Chirco, PE	20 Oct 08 Date
Approved by:	*Signed document on file* Ken Jong, PE, Engineering Manager	21 Oct 08 Date
Released by:	*Signed document on file* Anthony Daniels, Program Director	25 Oct 08 Date

Revision	Date	Description
0	25 Oct 08	Initial Release

Prepared by

for the California High-Speed Rail Authority

System Level Technical and Integration Reviews

The purpose of the review is to ensure:

- Technical consistency and appropriateness
- Check for integration issues and conflicts

System level reviews are required for all technical memorandums. Technical Leads for each subsystem are responsible for completing the reviews in a timely manner and identifying appropriate senior staff to perform the review. Exemption to the System Level technical and integration review by any Subsystem must be approved by the Engineering Manager.

System Level Technical Reviews by Subsystem:

Systems:	*Signed document on file* Eric Scotson:	04 Aug 08 Date
Infrastructure:	*Signed document on file* John Chirco:	26 Jun 08 Date
Operations:	*Signed document on file* Paul Mosier:	04 Oct 08 Date
Maintenance:	*Signed document on file* Paul Mosier:	04 Oct 08 Date
Rolling Stock:	*Signed document on file* Frank Banko:	02 Jul 08 Date

TABLE OF CONTENTS

ABSTRACT

The proposed California High-Speed Train System (HST) will operate adjacent to, in close proximity, or within a shared right-of-way with other transportation systems at several locations along the high-speed rail alignment. These transportation systems include conventional passenger railroad lines, freight railroad lines, and highways. At these locations, special considerations will be made to determine the need for intrusion protection. Identifying intrusion hazards in shared rights-of-way is a key safety issue for both the CHSTP and existing transportation systems. Reducing the risk of intrusion will allow the high-speed lines to operate adjacent to existing transportation systems in a safe and acceptable manner.

The purpose of this technical memorandum is to review current practices and to provide a basis of design for the safe separation of CHSR lines from adjacent transportation systems in order to:

- Prevent errant railroad or highway vehicles from intruding into the operating space of the high-speed lines from an adjacent or overhead facility
- Prevent a derailed high-speed vehicle from intruding into the operating space of an adjacent railroad or highway
- Prevent a derailed high-speed vehicle from falling from an elevated track

Development of the basis of design for intrusion protection will include, but not be limited to, a review and assessment of the following:

- The locations where the proposed CHSR lines may be adjacent to or on a shared right-of-way with conventional passenger railroads, freight railroads, and highways in to determine the level of exposure
- Existing FRA and AREMA guidelines regarding separation and protection of adjacent transportation systems and conventional railroads
- USDOT / FRA / ORD Report entitled, “Safety of High-Speed Guided Ground Transportation Systems, Intrusion Barrier Design Study” (November 1994), for applicability to CHSR issues
- Intrusion protection measures used on high-speed rail systems in Europe and Asia
- Research for other applicable published studies regarding the safe separation and intrusion protection for high-speed trains systems and adjacent transportation systems

Issues associated with shared-use operations, where high-speed trains share the same track with conventional passenger railroads, including operational and regulatory requirements, will be addressed in separate documents.

Access control and intrusion into the HST right-of-way by pedestrians or wildlife is not addressed in this paper and will be addressed in separate documents.

6.0 DESIGN MANUAL CRITERIA

6.1 INTRUSION PROTECTION

The following information applies to both shared and high-speed train corridors.

6.1.1 Protection of CHSTP Operating Infrastructure from Intrusion

The main principle of these design criteria is to protect the HST operational infrastructure in order to preserve safe and reliable HST operations. The area considered as Operating Infrastructure is defined as shown on the Figure 6.1-1:

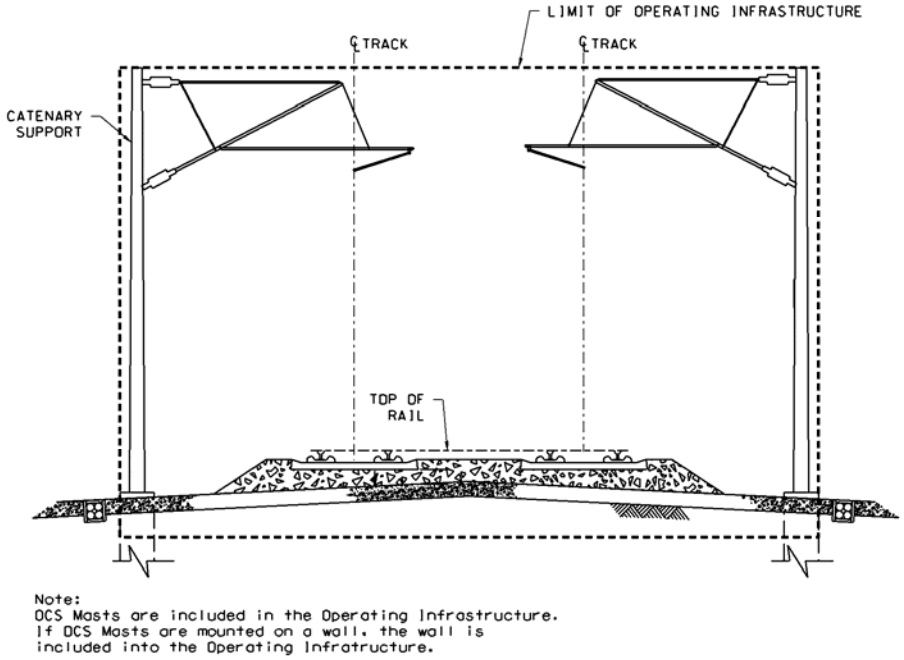


Figure 6.1-1: Limit of Operating Infrastructure

6.1.2 Containment of Conventional Trains

Conventional trains sharing corridors with HST will be prevented from intruding into the HST Operational Infrastructure by physical separation, or by a physical barrier where physical separation is not practical. Physical barriers may include earth berms or swales, and reinforced concrete or steel barriers designed to withstand the anticipated forces from a derailed conventional freight or passenger rail train set. Other mitigation measures could also include the use of check rails at particularly high-risk locations, such as bridge piers.

Protection Measures:

- Locate HST infrastructure at sufficient separation distances to avoid intrusion.
- Design supporting piers to mitigate impact loads.
- Place check rails on high risk lines, especially before and after bridge structures, in order to maintain derailed freight cars within their operating envelope.
- Install earth ditches and berms or other physical barriers between the closest tracks of the adjacent rail infrastructures.

Note that the intent of these measures is to maintain the train within its right-of-way and not to stop the train. Supplemental protection is achieved through the use of intrusion detection technology in the fencing around HST operations. If the intrusion detection system is activated, HST operation is stopped by the signaling system.

6.1.3 Containment of HST Trains

High-speed train sets will be contained within the operational corridor in order to reduce the potential for intrusion into an adjacent transportation corridor. Strategies to ensure containment include operational and maintenance plan elements, which will ensure high-quality tracks and vehicle maintenance to reduce the risk of derailment. In addition, physical elements, such as containment parapets, will be considered for specific areas with a high risk or high impact of derailment including, viaducts, tunnels, and approaches to conventional rail and roadway crossings.

- Ensure the highest appropriate level of maintenance of both infrastructure and rolling stock which will minimize the risk of derailment
- In general, check rails, guard rails and parapets can limit lateral movements, especially in high risk areas.
- On elevated structures, it is even more imperative that HST remains within its operational envelope. Protection can be provided by containment parapets.
- Tunnels: For twin bore, single-track tunnels, containment will be provided by the maintenance and evacuation walkways, which function like a containment parapet. For single bore, twin-track tunnels, additional containment can be provided between the tracks to prevent a secondary collision following initial HST derailment. All tunnels on the HST are currently anticipated to be twin bore with single-track tunnels.

6.1.4 Separation Distance between HST and Adjacent Railroad Systems

A range of separation distances with the associated protection follows. Distances are measured between the centerlines of the closest conventional rail and high-speed tracks.

- No intrusion protection is required for tracks with centerlines separated by 102 ft (31.0 m) or greater;
- Earthworks berms can be used as intrusion protection for tracks with centerline separation of 45 ft (13.7 m) or greater;
- A minimum 29 ft (8.8 m) separation is required between centerlines of HST and adjacent conventional railroad track and requires a physical intrusion barrier;
- The absolute minimum offset to any obstruction is defined by each operator plus the width of the intrusion protection.
- When intrusion protection is needed, minimum total height shall be 10 ft (3.0 m) with either ditch plus berm, concrete wall plus screen or only concrete wall

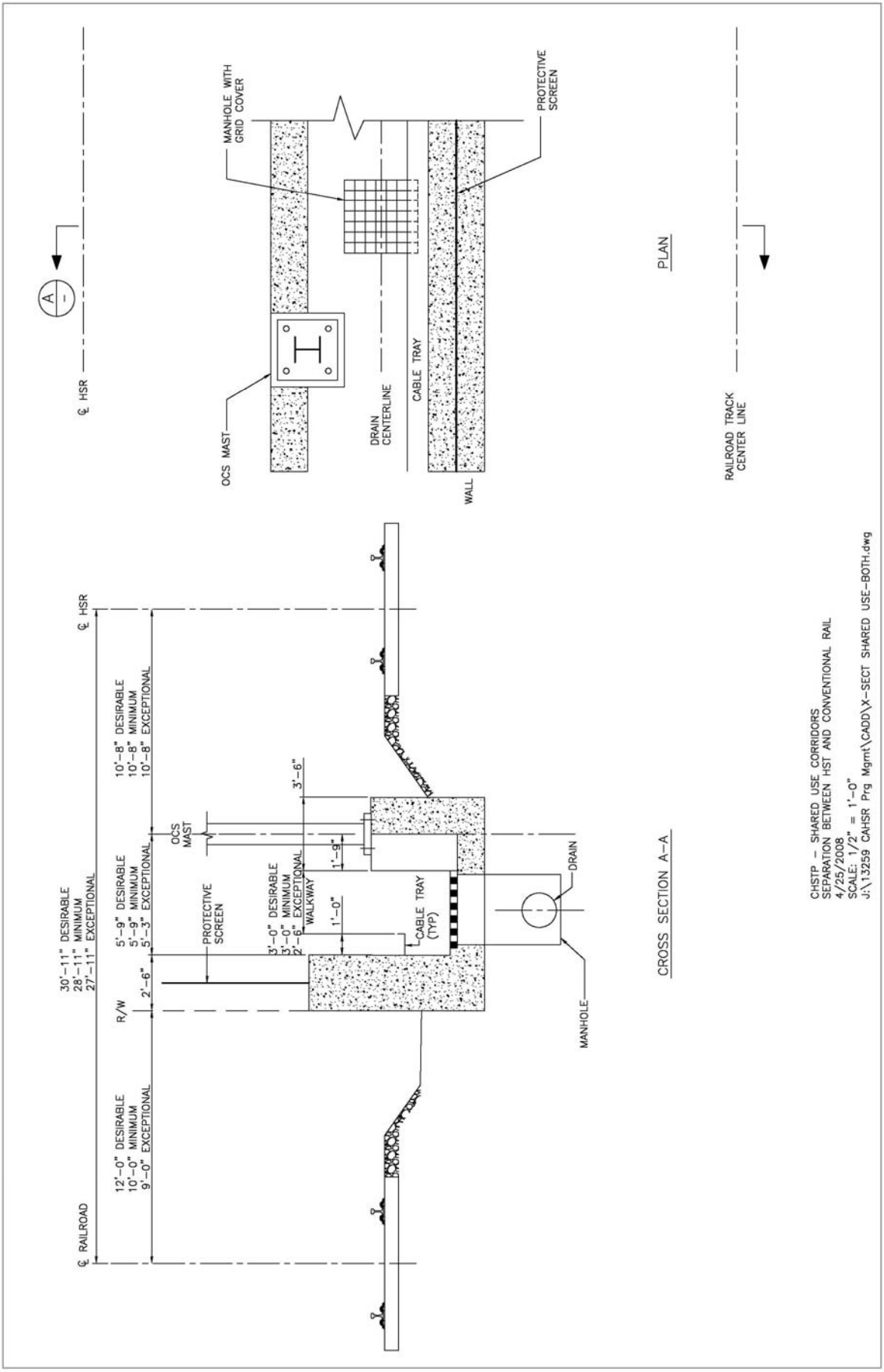
Intrusion protection, if required, is designed in conjunction with the hazard analysis, risk assessment to determine the necessity of the physical barrier.

6.1.5 Pier Protection for Grade Separated Projects

The minimum offset between pier and the closest track shall be 25 ft (7.6 m) as per AREMA recommendation. If this distance is not feasible, crash wall to protect the piers shall be installed.

APPENDIX A

A.1 TYPICAL CROSS SECTION WITH INTRUSION PROTECTION


℄ HSR
A
A
MANHOLE WITH GRID COVER
PROTECTIVE SCREEN
OCS MAST
DRAIN CENTERLINE
CABLE TRAY
WALL
PLAN
RAILROAD TRACK CENTER LINE
℄ HSR
℄ RAILROAD
30'-11" DESIRABLE
28'-11" MINIMUM
27'-11" EXCEPTIONAL
12'-0" DESIRABLE
10'-0" MINIMUM
9'-0" EXCEPTIONAL
R/W
2'-6"
5'-9" DESIRABLE
5'-9" MINIMUM
5'-3" EXCEPTIONAL
10'-8" DESIRABLE
10'-8" MINIMUM
10'-8" EXCEPTIONAL
OCS MAST
PROTECTIVE SCREEN
3'-0" DESIRABLE
3'-0" MINIMUM
2'-6" EXCEPTIONAL WALKWAY
1'-0"
3'-6"
1'-9"
CABLE TRAY (TYP)
DRAIN
MANHOLE
CROSS SECTION A-A
CHSTP - SHARED USE CORRIDORS
SEPARATION BETWEEN HST AND CONVENTIONAL RAIL
4/25/2008
SCALE: 1/2" = 1'-0"
J:\13259 CAHSR Prg Mgmt\CADD\X-SECT SHARED USE-BOTH.dwg