California High-Speed Train Project

TECHNICAL MEMORANDUM

Pantograph Clearance Envelopes

TM 3.2.3

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Released by:	*Signed document on file* _____ Anthony Daniels, Program Director	10 Aug 09 Date

Revision	Date	Description
0	17 July 09	Initial Release

Note: Signatures apply for the latest technical memorandum revision as noted above.

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	30 May 08 Date
Infrastructure:	*Signed document on file* _____ John Chirco	18 May 08 Date
Operations:	*Signed document on file* _____ Paul Mosier	2 Jun 08 Date
Maintenance:	*Signed document on file* _____ Paul Mosier	2 Jun 08 Date
Rolling Stock:	*Signed document on file* _____ Frank Banko	28 May 08 Date

Note: Signatures apply for the technical memorandum revision corresponding to revision number in header and as noted on cover.

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ABSTRACT

The California High Speed Train Project (CHSTP) will provide high-speed train service in the state of California with proposed terminal stations (end-of-line or end-of route) in Sacramento, San Francisco, Fresno, Bakersfield, Los Angeles, Anaheim and San Diego. Intermediate stations will serve locations along the alignment. For much of the alignment, high speed trains will operate along a dedicated track with stations that exclusively serve high speed train operations at 350 Km/h (220mph). There are also two locations (the Lossan and Caltrain corridors) where the proposed California High-Speed Rail (CHSR) line will operate within a shared right-of-way permitting a maximum speed of 125mph(201Km/h) with conventional passenger railroad lines.

The purpose of this technical memorandum is to review best practice and provide design criteria for the pantograph clearance envelopes to:

- Ensure safe clearances to pantographs as well as to the overhead contact system support structures in all rights of way in which the California High Speed Train (CHST) will operate
- Clearly define facility design parameters
- Minimize existing structures design restrictions

Development of the design criteria for pantograph clearance envelopes will include review and assessment of, but not be limited to, the following:

- Existing FRA, State of California General Orders, NESC, IEEE and NFPA guidelines where applicable to pantograph clearance envelopes
- Existing international standards, codes, best practices and guidelines used on existing High Speed Train Systems for applicability to the CHSTP.

As the Overhead Contact System for High Speed Trains has unique requirements for safe and efficient operations at high speeds, this memorandum will define the pantograph clearance and catenary space required for the sections of the CHSTP dedicated to high speed train operation only , e.g. up to 350 Km/h (220mph), and for the right of ways shared with conventional passenger trains, namely the Lossan and Caltrain shared use corridors where the speed will be lower, e.g. up to 125mph(201Km/h).

The current design practice for High-speed train pantograph gauges and electrical envelope of the OCS presently in operation throughout the world are considered in the development of the pantograph envelopes for the CHST project, and are referenced where appropriate.

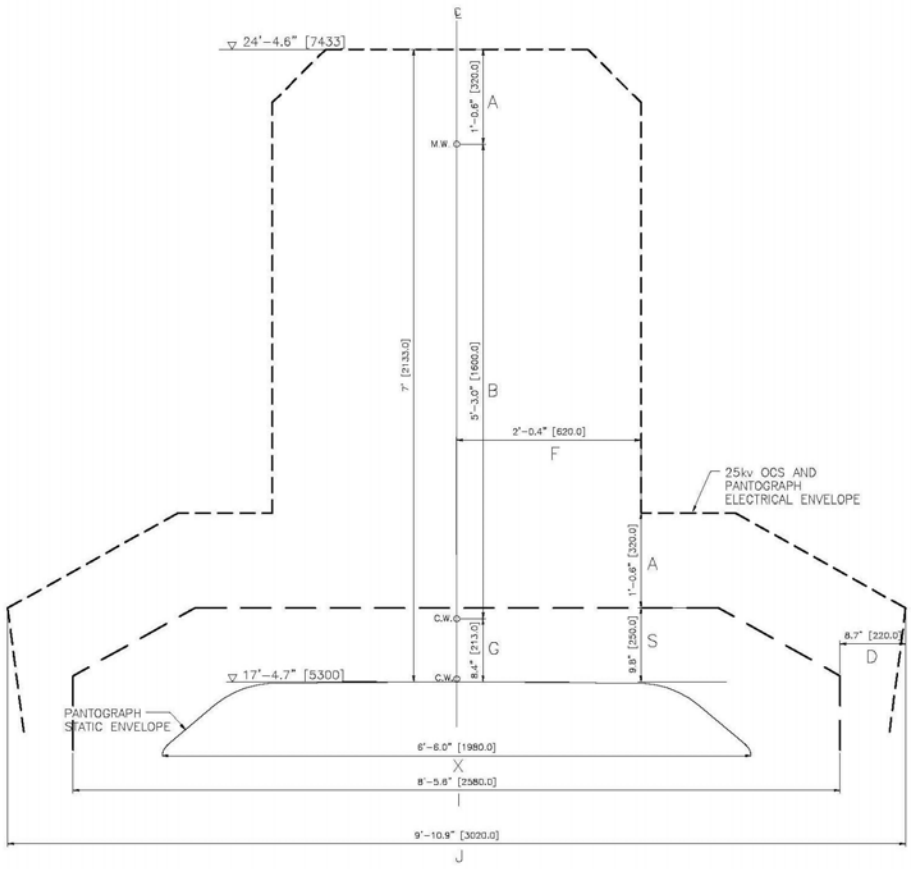
The design criteria developed in this Technical Memorandum are developed on the basis of the Technical Memorandum ref. TM 1.1.10 “Structure Gauge” which provides the static gauge, dynamic gauge and structure gauge of the high speed vehicles that are likely to be used on the sections of the CHSTP dedicated to high speed operation only, and the envelope of the static gauge, dynamic gauge and structure gauge of both the high speed vehicle and American passenger cars that will both operate in shared use corridors.
From this basis, the design defines a contact wire height for high speed dedicated sections that will be used by high speed vehicle gauge only and another contact wire height for shared use corridors above tracks where both high speed vehicle gauge and American passenger car gauge are to be considered. It does not however consider the contact wire height for the rolling stock depot / yard in which specific inspections and safety considerations for maintenance personnel may require other contact wire heights above dedicated specific maintenance tracks.

“Safety clearances” related to the height of the overhead contact system such as clearances of 25kV live parts above station platforms, or minimum heights of conductors above walkways or other accessible areas are not addressed in this document as they are provided in the “OCS Requirements” Technical Memorandum.

6.0 DESIGN MANUAL CRITERIA

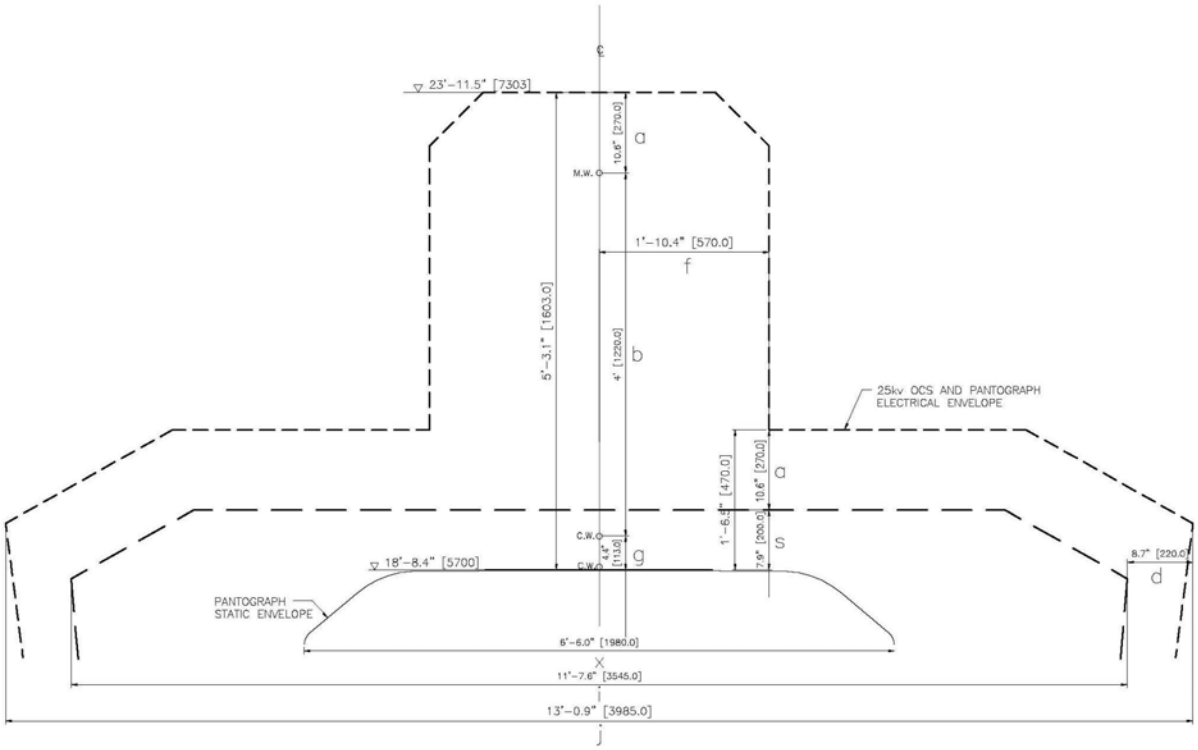
The dimensions data (rounded to the next 10mm) that are to be included in the Design Manual are:	
For the contact wire height:	
- for CHSTP sections dedicated to high speed only	17'-4.7"
- for CHSTP sections that are shared use corridors	18'-8.4"
For the pantograph:	
- a pantograph static dimension over the tips of the horn (as per the guideline recommendation of Chapter 33 of the AREMA Manual)	6'-6"
- for CHSTP sections dedicated to high speed only, a pantograph dynamic envelope to be used for design at support locations (with a contact wire height of 5300mm above top of rail)	8'-5.6" wide and a height of 18'-2.5" that includes uplift
- for CHSTP sections that are shared use corridors, a pantograph dynamic envelope to be used for design at support locations (with a contact wire height of 5700mm above top of rail)	11'-7.6" wide and a height of 19'-4.3" that includes uplift
For the pantograph and 25kV live catenary space envelope (between 2 supports):	
- for CHSTP sections dedicated to high speed only (with a contact wire height of 5300mm above top of rail), pantograph and catenary (excluding its associated negative feeder) electrical envelopes (to be used between two supports) of	
in alignment in open route	9'-10.9" x 1'-10.4" + 7'-0" x 4'-0.8"
in curved superelevated track in open route	9'-10.9" x 1'-10.4" + 7'-0" x 4'-1.2"
in alignment in tunnel	9'-10.9" x 1'-10.4" + 5'-4.3" x 4'-0.8"
in curved superelevated track in tunnel	9'-10.9" x 1'-10.4" + 5'-4.3" x 4'-1.2"
- for CHSTP sections that are shared use corridors (with a contact wire height of 5700mm above top of rail), pantograph and catenary (excluding its associated negative feeder) electrical envelopes (to be used between two supports) of	
in alignment in open route	13'-0.9" x 1'-6.5" + 5'-3.1" x 3'-8.9"
in curved superelevated track in open route	13'-0.9" x 1'-6.5" + 5'-3.1" x 3'-9.1"
in alignment in tunnel	13'-0.9" x 1'-6.5" + 4'-6.4" x 3'-8.9"
in curved superelevated track in tunnel	13'-0.9" x 1'-6.5" + 4'-6.4" x 3'-9.1"

APPENDIX



SPACE NECESSARY FOR 25KV OVERHEAD CATENARY SYSTEM
FOR CHSTP SECTIONS DEDICATED TO HIGH SPEED
FOR CONTACT WIRE HEIGHT OF 5300mm
IN OPEN ROUTE ALIGNMENT BETWEEN 2 SUPPORTS

A = Static electrical clearance per UIC-606
D = Passing electrical clearance per UIC-606
B = System depth dedicated to high speed (maximum system height of German ICE high speed OCS 5'-3"(1600mm), Japanese Shinkansen High speed OCS 4'-11"(1500mm) and French TGV High OCS 4'-7.1"(1400mm))
F = Wire deflection (maximum deflection of the contact wire under dynamic situation as recommended by the TSI standard for high speed lines) + D (Passing Electrical Clearance per UIC-606)
G = 5.9"(150mm) Wire uplift and hardware dimension + 2.5"(63mm) track and OCS tolerances
X = CHSTP combined maximum pantograph static envelope (see figure 3.4)
I = Total width of dynamic pantograph envelope per STI formula (= 2 x L2 see figure 3.5 and 3.7)
J = Total width of electrical envelope (= I + 2 x D)
S = Designed pantograph uplift for clearance purpose (see figure 3.5)



SPACE NECESSARY FOR 25KV OVERHEAD CATENARY SYSTEM
FOR CHSTP SHARED USE CORRIDORS
FOR CONTACT WIRE HEIGHT OF 5700mm
IN OPEN ROUTE ALIGNMENT BETWEEN 2 SUPPORTS

a = Static electrical clearance per UIC-606
d = Passing electrical clearance per UIC-606
b = System depth (4'-0"(1220mm)) for shared use corridors and is slightly larger than the maximum system depth of Germans (3'-7.3"(1100mm), Japanese (3'-7.3"(1100mm)), and French (3'-11.2"(1200mm)))
f = Wire deflection (maximum deflection of the contact wire under dynamic situation as recommended by the TSI standard for high speed lines) + d (Passing Electrical Clearance per UIC-606)
g = 2"(50mm) of uplift + 2.5"(63mm) of track and OCS tolerances
x = CHSTP combined maximum pantograph static envelope (see figure 3.4)
i = Total width of dynamic pantograph envelope per AREMA chapter 33 formula (=2Ss+X+E+2L see figure 3.8)
j = Total width of electrical envelope (= i + 2 x d)
s = Designed pantograph uplift for clearance purpose (see figure 3.5)