Caltrans / Industry Falsework Advisory Team

Meeting Agenda – September 2, 2021 (Thursday)

Location: WebEx Meeting

Time	Topic	Speaker
10:00 – 10:05	Welcome and WebEx Overview	Jim Nicholls /Steve Harvey
10:05 – 10:15	Follow up from previous meeting (1/19/2021) action items • History of protective covers through falsework **Minutes:** No additional information • Requirement for temporary structure engineer to analyze existing structure **Minutes:** Caltrans still looking into this issue. Pattern Slough is new project with this requirement and the designer will be contacted to determine the origin of requiring the temporary structure engineer to analyze the existing structure • Traffic connections ○ 2000# required per 48-2.02B(4) ○ Rebar dropped in oversized hole not addressed in NDS **Minutes:** Described the connection with ¾ rebar dropped in oversized hole through the corbel to the bottom of the pad. This type of connection is not addressed in the NDS. The closest connection in the NDS would be a dowel pin which required an undersized hole and additional penetration to compensate for not having a head on the connector. Without an adequate way to calculate the capacity the assembly should be load tested. Caltrans (CT) has noticed that calculations for this type of connection have not been performed by either the contractor or structure rep on some projects. When asked to provide calculations for this connection on a project recently submitted to CT neither the contractor or CT could confirm the connection would resist the 2000# load and a second rebar was added. Caltrans will notify field staff to request either calculations or test results to verify the connection in question has adequate capacity to resist the specified 2000# load.	Jim Nicholls

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10:15-10:25	Falsework Manual Revisions
	• Online at: https://dot.ca.gov/programs/engineering-services/manuals/falsework-manual
	• Revision 1 (September 2020)
	  ○ Revised timber pile figures in chapter 8
	• Revision 2 (February 2021)
	  ○ Figure 3-2, *Edge of Deck and Walkway Loading*, revised to clarify application of the 100 psf loading
	  ○ Typo in Figure 4-12, *Application of 2000 pound load*
	  ○ Section 4-12.05E 150% increased load on post at traffic openings revised to agree with Spec to apply to post only
	  ○ Section 5-2.04C shear V neglected for all loads a distance D from support revised to agree with NDS 3.4.3 reduce by x/D
	  ○ Section 6-3.02B combined bending when L>D revise to 4L>D per old manual
	• Revision 3 (August 2021)
	  ○ Correct typo referencing Figure 5-9 to Figure 3-9
	  ○ Add stream flow force equation to Chapter 3
	  ○ Correct typo in Table 5-4 commas in place of decimals
	  ○ Edit Figure 6-3, *Falsework Bent with Unequal Height Tiers*
	  ○ Removed requirement in Chapter 7 for second engineer check for metal shoring systems
	  ○ Removed limitation on screw jacks at base of metal shoring systems in Chapter 7
	  ○ Chapter 8 miscellaneous typos and formula corrections from ADA conversion
	  ○ Table 9-1, *Thimble Diameters,* changed from 1/8” to 1 1/8”
	  ○ Example Problem 4, *Wind Loads on Conventional Falsework*, revised to agree with procedure in chapter 5
	  ○ Example Problem D-18, *Cable Bracing – Bents*, references to tables corrected
	Minutes:
	• Discussed how the numbering of the revisions was changed from the original system for clarity.
	• Currently there have been 3 revisions mostly addressing typos
	• Team discussed the notable revisions and additions to the manual
	• Revision 4 is currently being drafted and will address the changes to temporary barriers. This is a topic for later today.
		Jim Nicholls

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10:25 – 10:45	Specification Changes
	• 16-2.02C *Construction*
	  ○ Temporary barrier to separate facility from vehicles and equipment
	  ○ Extend 4 feet past edge of work above
	  ○ Height 8 to 10 feet
	  ○ Meet requirements of 12-4.04C
	• Draft RSS 12-3.20 *Temporary Barrier Systems*
	  ○ Scheduled to be posted in October 2021
	  ○ Addresses existing products
	  ○ Development of Caltrans rail is ongoing
	  ○ Draft Spec based on requirements of Manual for Assessing Safety Hardware (MASH)
	  ○ New MASH standards increase the weight, angle of approach, and vertical distance to center of gravity of test vehicle
	  ○ For small cars, the test vehicle changes resulted in an increase of 206% in impact severity compared to the previous National Cooperative Highway Research Program (NCHRP) Report 350
	  ○ Spec 12-3.20C(2)(c) Do not install Type K railing after December 31, 2026
	  ○ Working width determination (Attachment 1)
	  ○ Clear area determination (Attachment 2)
	  ○ MASH requires at a minimum all barriers meet crash Test Level 3 (Attachment 3)
	  ○ RSS 12-3.20 based on TL 3 plus TL 4 roll over (Attachment 4)
	  ○ Distances measured in inches and rounded to nearest foot
	  ○ 12-3.20C(1) Minimum Clear Area Width table (Attachment 5)
	  ○ Draft SSP 12-3.20 contains location specific clear area width table rounded to the nearest 3 inches (Attachment 6)
	Minutes:
	16-2.02C *Construction*
	• Team discussed the notable changes to Section 16-2.02 and how it will affect temporary pedestrian covers and falsework designs
	• Extending the cover past the work (walkway above) will provide for safe passage for pedestrians
	• Height limits were added to eliminate using plywood attached to the bottom of falsework stringers as a protective cover.
	• Section 12-4.04C already required separation between equipment and pedestrians so was added to 16-2.02
		Jim Nicholls

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Specification Changes Minutes Continued:

- Section 16-2.02 did not address all ADA requirements previously
- Question was raised if a temporary barrier would be required at a sidewalk below falsework where protective cover is installed. CT response is the Spec requires a temporary barrier to be installed when adjacent to traffic but does not address this situation specifically.
- Some projects have placed temporary barriers in the gutter pan adjacent to the sidewalk
- Sidewalks are existing and not temporary
- This topic will be researched and placed on next meeting agenda

12-3.20 *Temporary Barrier Systems*

- Caltrans presented highlights what this draft will address
- Discussed the reason for the RSS and how the standards have changed
- Attachments 1 through 4 outlining the method for determining the required clear area behind temporary barriers was presented
- Attachments 5 showing the draft clear area table that will be found in RSS 12-3.20 was presented
- Attachment 6 with the location specific SSP 12-3.20 was discussed
- The Caltrans Temporary Structure Technical Team would like to provide the designers some guidance of when to implement SSP 12-3.20.
- The team was asked for suggested guidelines when SSP 12-3.20 would be used with the following suggestions:
  - When long spans are required
  - When vertical clearance is limited, 16’ or less
  - When large skews are present, 45 to 50 degrees
  - When additional space for traffic is required
- If not part of the contract the SSP could be added as CCO

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10:45 – 10:55	Alternatives to Falsework Manual Simplified Methods • The Falsework Manual represents Caltrans opinion on what constitutes “best general practice” • Manual uses simplified methods to facilitate the review process • Falsework Manual Section 1-3, *Statement of Department Practice* allows for more rigorous analysis *If the contractor’s design of an indeterminate element of the falsework system is based on a rigorous analysis as shown by design calculations, and requested in writing by the contractor, the system adequacy will be evaluated by a similar rigorous method of frame analysis. The reviewer should contact the Falsework Engineer at the SC HQ for assistance* • Use of more rigorous methods may extend the time for review **Minutes:** • More rigorous does not mean further simplification • Example of more rigorous calculation would be designing pads assuming a flexible foundation and modeling with soil springs • If method used that is not in the Falsework Manual the methodology and assumptions should be listed in the calculations to help facilitate the review of the submittal	Jim Nicholls
10:55 – 11:10	Tracking Grade 50 Steel Beams • Spec assume unidentified steel is A36 • How to identify properties of used beams • This issue is similar to grades of lumber after NDS was adopted **Minutes:** • Steel could be treated similar to timber grades after NDS was adopted • Difference between timber and steel is that timber is visually graded and steel is not • Comment was made that temporary structure engineer should be able to self-certify and include the mill certs • Used beams are difficult to match to a mill cert. • Marking beams would be helpful • TSTT will discuss this matter further	Jim Nicholls

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11:10 – 11:25	HDPE Plates for Redundant System for Temporary Support • HDPE plates in place of steel plates • HDPE light weight • Working temperature is 180 degrees and melting temperature 260 degrees • Not UV resistant leading to degradation of material • Nylon plates is an option **Minutes:** • Industry currently looking at 4 different alternative materials to steel • HDPE creeps over time • Other products have better modulus • Typical steel plate weigh 40# vs 0.5# for other materials • Some material are UV sensitive • Friction force in the alternative materials is much lower than steel • Resin material has a friction coefficient approximately ½ of steel and much higher than HDPE with little friction capabilities • Brian Mapel will test some materials but not until October and will share results with CT • Team discussed using a potential alternate material in a pilot project like a bearing replacement that will only lift the structure a small amount • Potential benefits of the lighter material would be cost and safety • Material cost for steel is $80 vs $26 for alternatives • After an alternate material is proposed Special Provisions will need to be developed to ensure quality of the material and limits on use • Alternate material would be a bigger concern if traffic is on the structure • This topic will be discussed at the next FWAT meeting	Jim Nicholls/ Brian Mapel

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11:25 – 11:40	Falsework Pads Design Based on Flexible Footings: • Rigorous method noted in Falsework Manual 1-3 • Methods for determining modulus of subgrade reaction (soil springs) *The modulus of subgrade reaction or soil springs can be estimated using the procedure presented by Bowles as follows:* $k = \frac{12}{\Delta H}(q_u)$ $q_u = ultimate\ soil\ pressure\ \left({}^{k}/_{ft}\right)$ $q_a = {}^{q_u}/_{SF} = allowable\ soil\ pressure\ \left({}^{k}/_{ft}\right)$ *SF = factor of safety (FS = 2 for typical falsework designs)* *ΔH = displacement at ultimate soil pressure (in) default to 1 inch* *k = spring constant* $\left({}^{k}/_{ft^3}\right)$ *References:* *Foundation Analysis and Design (Fifth Edition) – Joseph E. Bowles* **Minutes:** • Presented the above method for approximating soil springs in an effort to expedite the review process. If using the same method, the results should be similar. • Others in the group have seen or used the Bowles method and found it to be acceptable • CT will post this method on its internal web site for field personnel to used when flexible foundations are being analyzed • Comment was made that 1-inch deflection used as a default in the above formula is similar to what is used in falsework design	Jim Nicholls
11:40 – 11:59	Round Table **Minutes:** • Comment made NDS is going well • Many designers were already using NDS • Question was asked about the origin of the 150% post load adjacent to traffic openings. CT explained is was related to stiffer soil properties around roadway and based on full scale testing many years ago • TSTT will revisit the 150% post load requirement • Suggestion was made to adjust the 150% to a lesser value • With NDS reducing capacity it was questioned if the 150% increase is needed	Open Discussion

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	Round table continued: • CT will look into doing some testing related to post loads adjacent to traffic • Suggestion made to do some 3D modeling of falsework supported structures with varied soil properties to see how loading to the post varies	
12:00	Adjourn **Minutes:** • Next meeting will be end of January or beginning of February	All

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Action Items:

Items from Meeting on 1/19/21

1. CT will research history of Spec requiring protective pedestrian covers under falsework
2. CT will research requirements for temporary structure engineer to analyze existing bridge structure for next FWAT meeting
3. CT will notify FWAT of future revisions to the Falsework Manual

Today's Action Items

1. CT will research Spec requiring temporary barriers at pedestrian covers when placed over an existing sidewalk. Topic will be on next FWAT agenda.
2. TSTT will revisit the 150% post load adjacent to traffic and add to next FWAT agenda
3. TSTT will discuss the tracking of steel grades and add to next FWAT agenda

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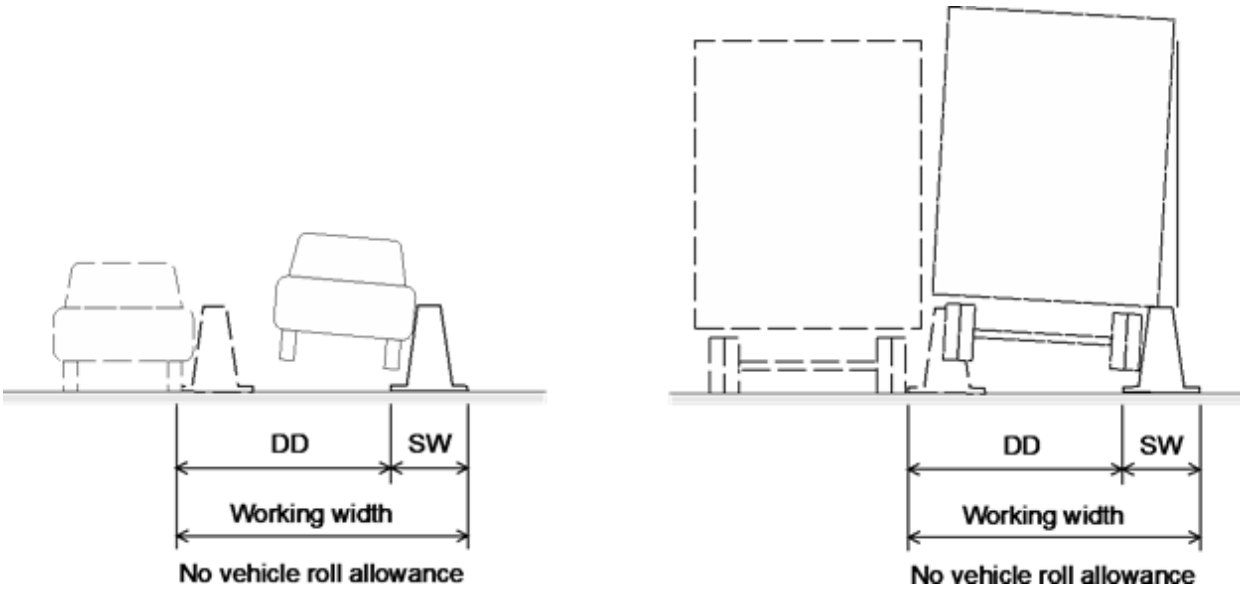
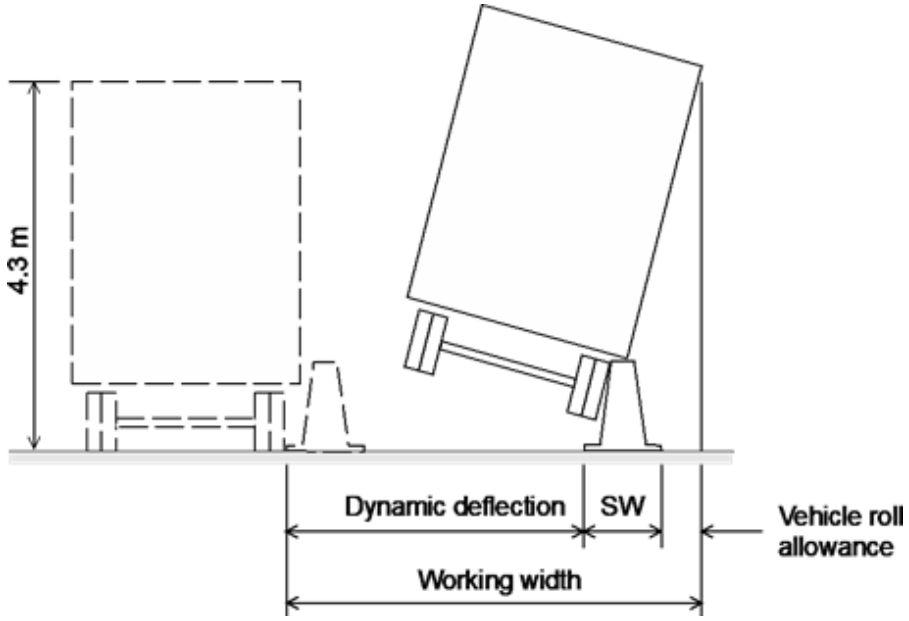
Attachment 1



DD - Dynamic Deflection
SW - System Width

Working Width, No Rollover



SW - System Width

Working Width Including Rollover

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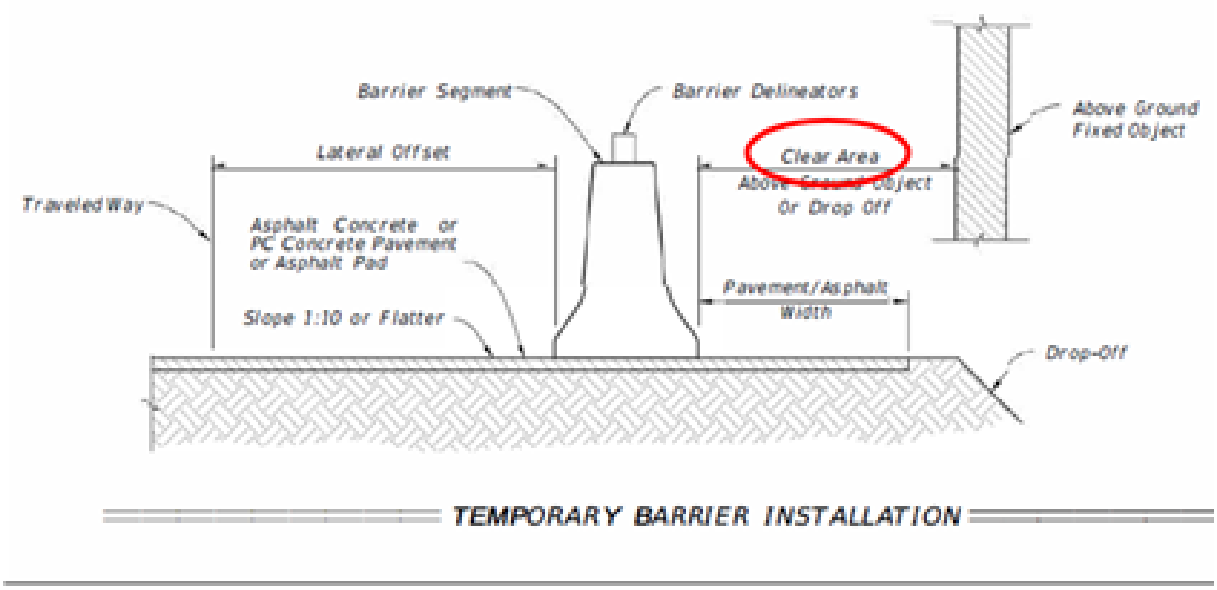
Attachment 2



TEMPORARY BARRIER INSTALLATION

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Attachment 3

Table 1 MASH Test Matrix for Traffic Barrier Systems				
Test Level	Test Vehicle Designation and Type	Test Conditions		
		Vehicle Weight kg [lb]	Speed km/h [mph]	Angle Degree
1	1100C (Passenger Car)	1,100 [2,420]	50 [31]	25
	2270P (Pickup Truck)	2,270 [5,000]	50 [31]	25
2	1100C (Passenger Car)	1,100 [2,420]	70 [44]	25
	2270P (Pickup Truck)	2,270 [5,000]	70 [44]	25
3	1100C (Passenger Car)	1,100 [2,420]	100 [62]	25
	2270P (Pickup Truck)	2,270 [5,000]	100 [62]	25
4	1100C (Passenger Car)	1,100 [2,420]	100 [62]	25
	2270P (Pickup Truck)	2,270 [5,000]	100 [62]	25
	10000S (Single Unit Truck)	10,000 [22,000]	90 [56]	15
5	1100C (Passenger Car)	1,100 [2,420]	100 [62]	25
	2270P (Pickup Truck)	2,270 [5,000]	100 [62]	25
	36000V (Tractor/Van Trailer)	36,000 [79,300]	80 [50]	15
6	1100C (Passenger Car)	1,100 [2,420]	100 [62]	25
	2270P (Pickup Truck)	2,270 [5,000]	100 [62]	25
	36000T (Tractor/Tanker Trailer)	36,000 [79,300]	80 [50]	15

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Attachment 4

Zoneguard Standard System	MASH TL-3	Staked or anchored at both ends only	--	96[4]	28	--	23	119	10
Zoneguard Standard System	MASH TL-3	Anchored Every 250 feet	103.0	82.0	28	75	23	103	9
Zoneguard Minimum Deflection System	MASH TL-3	Anchored Every 33.33 feet	51	23.4	28	23	23	46	4

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Attachment 5

Install the temporary barrier system based on the requirements shown in the following table:

Minimum Clear Area Width

Barrier	Configuration	Height differentials 3 feet or less (ft)	Height differentials greater than 3 ft up to 8 feet (ft)	Edge of deck or height differentials greater than 8 feet (ft)	Fixed objects, Falsework piles or temporary supports[a] (ft)
12'-6" temporary concrete barrier with "J" hooks	Freestanding	3	4	8	7
	3 stakes per segment traffic side	1	1	2	3
	2 anchor bolts per segment traffic side	1	1	2	3
20-foot temporary concrete barrier with "J" hooks	Freestanding	3	4	8	7
	4 stakes per segment traffic side	1	1	2	3
	3 anchor bolts per segment traffic side	1	1	2	3
50-foot temporary steel barrier	Staked or anchored at both ends only	6	7	8	9
	Staked or anchored every 250 feet	4	6	8	9
	Staked or anchored every 33 feet	1	1	3	4
20-foot Type K temporary railing	Freestanding	2	3	8	7
	2 stakes or 2 anchor bolts per segment traffic side	1	1	3	4
	4 stakes or 4 anchor bolts per segment	N/A	N/A	3	3

[a]When falsework piles or temporary supports have footings, subtract 2 feet from the clear area width shown and measure clear area width to the footing side closest to traffic.

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Attachment 6

Install the temporary barrier system based on the requirements shown in the table titled "Minimum Constricted Clear Area Width", for the locations identified in the following table:

Constricted Clear Area Locations

Location	Route	Begin postmile/station	End postmile/station

Minimum Constricted Clear Area Width

Barrier	Configuration	Falsework or Temporary Supports	
		Footings	Piles and other members
12.5-foot temporary concrete barrier with "J" hooks	Freestanding	5'-6"	7'-0"
	3 stakes per segment traffic side	0'-9"	2'-9"
	2 anchor bolts per segment traffic side	0'-6"	2'-3"
20-foot temporary concrete barrier with "J" hooks	Freestanding	5'-6"	7'-0"
	4 stakes per segment traffic side	0'-9"	2'-9"
	3 anchor bolts per segment traffic side	0'-6"	2'-3"
50-foot temporary steel barrier	Staked or anchored every 250 feet	7'-0"	8'-9"
	Staked or anchored every 33 feet	2'-0"	4'-0"
20-foot Type K temporary railing	Freestanding	3'-9"	7'-0"
	2 stakes or 2 anchor bolts per segment traffic side	1'-3"	3'-3"
	4 stakes or 4 anchor bolts per segment	0'-3"	2'-6"