Revision Of Section 630
Smart Work Zone System

NOTICE

This Project Special Provision revises or modifies CDOT's *Standard Specifications for Road and Bridge Construction*. These are the official instructions for its use on CDOT construction projects, and the Construction Engineering Services Branch has reviewed, approved, and issued it. Use as written without change. Other than the instructions given, do not modify this PSP on CDOT construction projects. Do not use this special provision on CDOT projects in a manner other than specified in the instructions without approval by CDOT's Standards and Specifications Unit. The instructions for use appear below.

Other agencies using the CDOT *Standard Specifications for Road and Bridge Construction* to administer construction projects may use this special provision appropriately and at their own risk.

Instructions for use on CDOT construction projects:

Review this guidance and make revisions as needed throughout the Spec. Delete this page when incorporating into the project special provisions package.

All projects deploying a Smart Work Zone System, for use in conjunction with the Standard 630 Specification, Construction Zone Traffic Control.

This specification must be used in conjunction with the Revision of Section 630: Smart Work Zone Devices. All requirements for both specifications must be met.

For all projects that are more than 6 months in duration, the designer shall:

1. Change the System measurement from Day to Month in the *Method of Measurement* section, including changing all references to daily measurement to monthly.

2. Change the System payment from Day to Month in the *Basis of Payment* section, including changing all references to daily payment to monthly.

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Revise Section 630 of the Standard Specifications for this project to include the following:

Text highlighted in blue may be revised based on the SWZ duration. All other text shall never be revised or omitted from the specification.

Revise Section 630.01 to include:

Description

A Smart Work Zone (SWZ) comprises standalone or connected devices that assess real-time traffic conditions to generate actionable intelligence for improving safety and mobility in a work zone. An SWZ System shall consist of portable, connected detection and surveillance equipment, a data processing software, communications between temporary Intelligent Transportation System (ITS) devices, electronic information dissemination tools, and one or more of the following subsystems: queue warning, dynamic lane merge, travel time information, incident detection, speed and volume monitoring, construction vehicle ingress notification, overheight vehicle detection, hazardous condition notification, and temporary ramp metering.

The purpose of an SWZ System is to provide advanced real-time traffic condition information to motorists at key decision points within the construction boundaries of a given project. An SWZ System shall be in operation 24 hours per day, seven days per week during the designated construction period.

This work consists of furnishing, installing, operating, maintaining, servicing, removing, and reporting an SWZ System per the requirements of this special provision, throughout the duration of the project. This work shall include submission and approval of an SWZ System Plan to meet the deployment requirements in the Plans.

The Contractor shall be responsible for meeting all requirements outlined. The Contractor may employ an experienced Vendor to meet these requirements. A Vendor is defined as the supplier of SWZ devices and SWZ data processing software.

Abbreviations

Wherever the following abbreviations are used in these specifications, they are to be construed the same as the respective expression shown below.

CCTV	Closed Circuit Television
ITS	Intelligent Transportation Systems
MVRD	Microwave Vehicle Radar Detector

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PFB	Portable Flashing Beacon
PHMB	Portable Hybrid Message Board
PTS	Portable Traffic Signal
PTSM	Portable Traffic Speed Monitor
PVMS	Portable Variable Message Sign
PVSL	Portable Variable Speed Limit Sign
PWMS	Portable Weather Monitoring Station
SWZ	Smart Work Zone
WZDx	Work Zone Data Exchange

Revise Section 630.09 to include:

Materials

An SWZ System shall consist of at least one subsystem described in Table 630-01 to manage and control traffic. The subsystems described below are non-exhaustive and may evolve for various traffic conditions. Each subsystem shall be scalable and flexible to accommodate any number of SWZ devices. The detailed specifications for all devices can be found in Revision of Section 630, Smart Work Zone Devices.

Table 630-01.
Description Of Common Swz Subsystems

Subsystem	Purpose	Applicable Smart Devices[1]
Queue Warning	Monitor traffic speeds and queue length to disseminate warnings in advance of the project area.	Portable MVRD[2], PVMS Panel, SWZ Data Processing Software, Portable CCTV[3]
Dynamic Lane	Display information in advance of lane	Portable MVRD[2], PVMS Panel,

Merge	closures to support merging of travelers upstream.	SWZ Data Processing Software, Arrow Panel[3], Portable CCTV[3]
Travel Time Information	Determine travel time between two set locations, using real-time calculations and historical data, to disseminate information to travelers. Notify travelers of delays or available alternate routes.	Portable MVRD[2], PVMS Panel[3], PHMB[3] SWZ Data Processing Software
Incident Detection (Project Surveillance)	Automatically detect incidents that occur among travelers or between travelers and construction vehicles to improve incident management response and prevent widespread congestion or traffic slowdown.	Portable MVRD[2], Portable CCTV, SWZ Data Processing Software, PVMS Panel[3], Audible or Visual Alarms[3]
Speed and Volume Monitoring	Detect, process, and disseminate real-time vehicle speeds to travelers for improving compliance with work zone speed limits. Works in conjunction with other related subsystems and allows for monitoring of overall work zone performance.	Portable MVRD[2], SWZ Data Processing Software, PTSM[3], PVMS Panel[3], Portable CCTV[3], PVSL[3]
Construction Vehicle Egress Notification	Notify travelers of construction vehicles exiting the active construction area and merging into mainline traffic.	Portable MVRD[2], PVMS Panel, SWZ Data Processing Software, Audible or Visual Alarms[3], PFB[3]
Overheight Vehicle Detection	Notify overheight vehicles approaching an area with low clearance and reroute or stop travel via dynamic messaging.	Portable MVRD[2], Audible or Visual Alarms, PVMS Panel, SWZ Data Processing Software, PFB[3]
Hazardous Condition Notification	Notify travelers of hazardous road conditions due to fog, rain, snow, or variable temperatures. Works in conjunction with other related subsystems.	PWMS, PVMS Panel[3], PVSL[3], SWZ Data Processing Software

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Temporary Ramp Metering	Meter traffic entering a highway at locations where there is potential for congestion.	Portable MVRD[2], PTS, SWZ Data Processing Software, PVMS Panel[3], Portable CCTV[3]
Variable Speed Limit	Provides speed limit changes in real-time to improve speed harmonization through the work zone, reducing speed for traffic incidents or reacting to changing weather conditions.	Portable MVRD[2], PVSL, SWZ Data Processing Software, PTSM[3], PWMS[3]
1. All devices shall conform to the requirements in Revision of Section 630: Smart Work Zone Devices.	2. A Portable Doppler Radar (SWZ) or other non-intrusive traffic sensor may be used in place of a Portable MVRD (SWZ), ensuring intended functionality of the subsystem.	3. These devices are optional but can be included for additional detection or information dissemination.

The Contractor shall be responsible for all setup and configuration of SWZ subsystems. To monitor and manage all subsystems, the SWZ System shall comply with the following requirements:

(a) *SWZ Data Processing Software.* An SWZ data processing software shall be provided for managing the SWZ System. The SWZ data processing software shall meet the minimum requirements detailed in the Materials section, subsection E of the Revision of Section 630: Smart Work Zone Devices.

(b) *Data Archive.* This work shall consist of configuring and storing work zone data for access by CDOT and relevant third parties. The SWZ data processing software shall meet the following minimum requirements:

(1) Store password-protected historical data for each day the system is in use.

(2) Archive daily recorded speeds, volume, occupancy, travel time, message display history, congestion duration, sensor status, sensor data, camera footage, and all other necessary metrics as determined by CDOT.

(a) The archive shall have time and date stamps for all data.

    (b) The archive shall include device installation dates for maintenance and repair purposes.

    (c) The archived data shall be accessible for at least three years past the end of the project or until the data is downloaded to a CDOT server, whichever occurs sooner.

(3) Be designed to allow up to 10 users to access the information simultaneously.

(4) Allow for quick and easy export to Microsoft Excel or similar data visualization software for both current and historically collected data. The export shall be capable of customizing output for specific devices, time periods, or other project-specific parameters.

(c) *Work Zone Data Exchange (WZDx).* The Contractor shall coordinate with CDOT to furnish an SWZ device data feed to CDOT per FHWA's WZDx Device Feed Specification. The Contractor shall meet the minimum requirements detailed in the Materials section, subsection F of Revision of Section 630: Smart Work Zone Devices.

Revise Section 630.13 to include:

Construction Requirements

The Contractor shall provide all equipment, supplies, materials, and labor to operationalize the SWZ System. The Contractor shall be locally available seven days per week and 24 hours per day while the system is deployed and shall attend all construction meetings facilitated by the Engineer.

(a) SWZ System Plan. The Contractor shall submit a written and illustrated SWZ System Plan which shall include all items in the SWZ Plan found in Revision of Section 630, Smart Work Zone Devices. The SWZ System Plan shall also contain these items:

(1) The proposed process for reconfiguring subsystems, as needed or directed by the Engineer.

(2) The proposed process for training the Engineer and all other designated project staff, as applicable.

(3) The proposed methods of communication between all SWZ devices and the SWZ data processing software. All communication required between subsystems shall be described in detail.

(4) The proposed logic and associated user-defined thresholds for all SWZ devices, for the purpose of testing before the SWZ System is "live." All logic shall address free flow (above 45 mph), moderate (between 20 and 45 mph), and heavy traffic conditions (below 20 mph). All historical data used to define logic thresholds shall be made available to the Engineer.

(5) The proposed methods for fulfilling the 5-day operational test, ongoing reliability and accuracy tests, and monthly system performance reports. The Contractor shall outline the

procedures, including required support from the Vendor or Engineer, for ongoing reliability and accuracy tests.

The Contractor shall submit the SWZ System Plan to the Engineer, Staff Traffic, and CDOT ITS for approval no later than 30 days prior to setup of the SWZ System. All parties shall have no more than seven business days to review the SWZ System Plan and return revisions or written approval to the Contractor. The Contractor shall also provide written confirmation seven days in advance of all proposed changes to the SWZ System Plan.

(b) Operational Testing Procedure. Once the SWZ System is installed, it shall undergo a 5-day continuous operational test. The operational test shall consist of the SWZ System in operation with appropriate traffic control to address safety concerns while physically accessing each subsystem. The operational test is to ensure that all SWZ subsystems are operating in a fully functional manner per the SWZ System Plan. The Contractor shall provide for complete operations support from the Vendor, if applicable, during the operational test, and the Contractor shall provide verification that all reported data accurately reflects actual field conditions.

The operational test shall include pushing sample device data in a WZDx-compliant Device Feed to the CDOT-provided secure, encrypted endpoint. The sample Device Feed shall include the CDOT-provided Planned Event identifier number for each device to link with CDOT's Work Zone Feed. Refer to all integration details in the *Materials* section, subsection F of the Revision of Section 630: Smart Work Zone Devices.

If an SWZ subsystem is offline or malfunctions for a cumulative period of four hours or more during this operational test on any day, no credit will be given for that day for the operational test period, and the 5-day operational test will reset. No field construction activity can commence until CDOT's approval of the operational test.

Records must be maintained for stoppages and resumptions during the operational test for submission to the Engineer. An operational test report must be submitted to provide accurate date and time of all activity, as well as:

 (1) Specific subsystem where work was performed.

 (2) Cause of subsystem malfunction, if known.

 (3) Description of the type of work performed.

 (4) Time required to complete the repair.

 (5) Any issues pertaining to publishing the sample WZDx Device Feed, with resolution.

The operational test report must be submitted to the Engineer for approval no later than five days after the completion of the test. An initial payment for the SWZ System setup will be rendered after approval of the operational test report.

(c) SWZ System Configuration. All configuration of the SWZ System shall be temporary and require no drilling or excavation except as approved by the Engineer. The SWZ System shall provide full functionality when subsystems are reconfigured and shall be modified as needed to provide real-time traffic data. The Contractor shall ensure the SWZ System remains in

place and operational until after all subsystems are removed from the project at the direction of the Engineer.

(d) Performance Testing Procedures. The SWZ System shall be reliable and accurate. An SWZ System is deemed reliable if all subsystems are online, fully functional, consistently sending and receiving data, and maintaining these characteristics upon all reconfigurations. If the SWZ System does not meet the reliability requirement, the Contractor shall recalibrate and adjust the equipment.

An SWZ System is deemed accurate if all subsystems are collecting, processing, and disseminating real-time traffic information without lapse or anomaly. The Contractor shall verify the accuracy of the SWZ System by testing each component to ensure the data transmitted and information disseminated reflect actual field conditions. The Contractor shall conduct field inspections monthly or after a major configuration change, whichever is sooner. All field inspections must be logged, dated, and submitted to the Engineer for approval. The Contractor shall be responsible for all inaccurate data, including false alarms and misinformation disseminated to the public. Inaccurate data shall be corrected within one hour of notification from the Engineer to avoid payment penalties.

The Contractor shall submit a monthly SWZ System Performance Report to the Engineer documenting the results of the ongoing reliability and accuracy tests, as well as all outstanding issues or repairs needed for the SWZ System or an individual subsystem.

(e) Project Deliverables. The Contractor shall submit the following to the Engineer for information, acceptance, or approval in accordance with the specified timeframes.

Table 630-02.
Project Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
SWZ System Plan	Approval	30 days prior to SWZ System setup
Operational Test Report	Acceptance	5 days after completion of test
Monthly System Performance Report	Acceptance	Monthly

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Revise Section 630.18 to include:

Method Of Measurement

Smart Work Zone System (Setup) shall be measured as a lump sum payment and shall include successful configuration and integration of the SWZ System, approval of the Operational Test Report, and completion of any necessary training for the Engineer and all other designated project staff.

Smart Work Zone System shall be measured by the day.(Change from "day" to "month" for projects longer than 6 months in duration.) The system measurement shall include all subsystem integration and calibration required to make the SWZ System functional and operational. The measurement shall include all submittals, materials, equipment, and labor necessary to complete the work. Any reset of SWZ subsystems shall be incidental to the system measurement, including resetting a subsystem to its original configuration. Any integration of an SWZ subsystem with the SWZ Data Processing Software shall be incidental and not measured for payment. Omit the SWZ Data Processing Software (630-88011) lump sum item, as defined in the Revision of Section 630: Smart Work Zone Devices, when an SWZ System is selected.

The Contractor shall identify and make all necessary corrections or repairs to an SWZ System that is deemed non-operational by the Engineer. A non-operational system is defined as a system that is offline, physically malfunctioning, reporting inaccurate data, interfering with construction activity, or inhibiting the performance of other SWZ subsystems.

No pay deduction will occur for a non-operational system if hardware and software corrections are made within 24 hours of notification and any inaccurate data or messaging is remedied within one hour of notification. Otherwise, pay deduction will be imposed after the grace period at $250 per day per non-operational subsystem, with an additional $500 per day for each day the entire SWZ System is inoperable or does not meet the requirements outlined in this specification. There shall be no limit on this penalty.

The Engineer reserves the right to permanently remove an SWZ subsystem if they determine that the system is not performing per this specification, at which point no further payment will be made for the removed subsystem.

Revise Section 630.19 to include:

Basis Of Payment

Payment is considered full compensation for all work, materials, labor, and incidentals related to configuring, operating, and maintaining the SWZ System per the Plans, Specifications, and the approved SWZ System Plan.

Payment will be made under: These items are used for initial setup and ongoing operations of the SWZ System. These items are required for all projects.

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Pay Item	Pay Unit
Smart Work Zone System (Setup)	Lump Sum
Smart Work Zone System	Day
Smart Work Zone System	Month
F/A Smart Work Zone	F A

Smart Work Zone System (Setup) lump sum payment shall be full compensation for initial configuration, integration, and training for all subsystems. This payment shall be rendered upon approval of the Operational Test Report by the Engineer.

Smart Work Zone System daily (Change from "daily" to "monthly" for projects longer than 6 months in duration.) payment shall be full compensation for operating, testing, reporting, and maintaining the system; furnishing the software, assigning and configuring user accounts, integrating and testing devices, operating and managing device data and control, monitoring and reporting digital device records, furnishing a WZDx-compliant SWZ data feed, and troubleshooting software deficiencies.

F/A Smart Work Zone payment covers unanticipated SWZ System costs associated with changes to SWZ device quantities. Payment will be made in accordance with subsection 109.04.