284 Toll Gantries

284.1 Gantry Types

(1) Non-accessible gantries – See ***Structures Manual, Volume 3 (SM, V3) 19.1.3***. The two types of non-accessible gantries are:

(a) Non-accessible cantilever.

Non-accessible cantilever gantries may be installed at ramp toll sites and express lane toll sites, only where the design satisfies the span limitations identified in ***FDM 284.1.1*** and ***SM, V3 19***, and cable distances identified in ***FDM 282.5*** can be met.

(b) Non-accessible span

Non-accessible span gantries may be installed at ramp toll sites, and express lane toll sites.

See ***Exhibit 284-1*** to identify the various elements of a non-accessible gantry.

(2) Accessible gantries (span only) – See ***SM, V3 19.1.4***.

A detailed investigation is required for the selection of the gantry type. Mainline toll gantries are assumed to be accessible gantries. A study must include justification that must be documented in the Toll Siting Technical Memorandum (TSTM), to determine when a mainline toll site will be a non-accessible gantry. Investigation considerations should include but are not limited to existing and proposed site conditions, manufacturing limitations, maintainability, site safety, and project costs. The gantry type must be determined during the PD&E phase in accordance with ***FDM 280.10.2***.

The accessible gantry provides a deck (walkway) to install and maintain equipment over live traffic and allows for secured access to the deck via an elevated platform and connecting stairway accessible by maintenance vehicles such as scissor lift or bucket truck. See ***Exhibit 284-2***, ***Exhibit 284-3***, ***Exhibit 284-4***, ***Exhibit 284-5***, ***Exhibit 284-6***, ***Exhibit 284-7***, and ***Exhibit 284-8*** to identify the various elements of an accessible gantry.

284.1.1 Gantry Design Criteria based on Toll Equipment Requirements

(1) See ***FDM 281.1.2*** for gantry positioning requirements.

(2) The tolling equipment positioning depends on the TEC and the roadway configuration at the gantry. See ***Exhibit 284-1*** and ***Exhibit 284-2*** for toll equipment

layout and positioning over the lanes for each gantry type. See ***Exhibit 284-11*** for equipment loading.

(3) All lanes and shoulders within the toll loop pavement area must receive toll equipment as identified in ***Exhibit 284-9*** and ***Exhibit 284-10***.

(4) The gantry must be designed to accommodate the TEC requirements for the following roadway configurations:

(a) Each interim or phased condition

(b) The ultimate condition

(c) Each potential TTC phase required to transition to final configuration or from the interim to the ultimate condition

(5) A single gantry structure design must allow the J-arms to be installed laterally along the gantry to accommodate all vendor equipment layouts for all interim and ultimate configurations.

(6) Gantry design must take into account layout for the following:

(a) Horizontal and vertical supports

(b) Raceways and wiring

(c) Toll equipment clearances

(d) J-arm adjustments

(e) Equipment positioning, and separation

(f) Line-of-sight of illuminators, auditing cameras, Violation Enforcement System (VES) cameras, and lasers/sensors

(g) AVI Readers and their enclosures/cabinets

(h) All associated equipment mounting hardware

(7) Cantilever Gantry must extend a minimum one foot beyond:

(a) **Express Lane Sites**: the centerline of the adjacent GUL

(b) **All other Sites**: the centerline of the far shoulder

284.1.1.1 J-arm Positioning on Gantry

The approach and departure J-arm centerlines must be equidistant from the gantry centerline as per the following:

(1) Non-accessible gantry – 5 feet, 9 inches

(2) Accessible gantry – 5 feet, 9½ inches

284.1.1.2 Vertical Clearance

(1) The following vertical clearances must be provided within the toll loop pavement area, for all interim and ultimate conditions:

(a) Eighteen feet, six inches (18’-6”) to the bottom of the J-arm for all gantry-mounted toll equipment devices except the vehicle detection and classification system (VDAC) laser unit. The VDAC laser unit system must be twenty-four feet, six inches (24’-6”) to the top of the J-arm. This clearance is the distance above the traffic lane or shoulder directly below.

(b) A minimum of 18 feet for any gantry structural element. This clearance is the least distance between the lowest point of any structural element (gantry or support framing) and the traffic lane or shoulder directly below.

(2) Use the APE to set the truss elevation to ensure that the J-arm adjustability above the roadway surface as defined in ***SM, V3 19.2.3*** is not exceeded along the cross slope of the toll loop pavement area. See ***FDM 281.1.2*** for additional information.

(a) The truss elevation must be a constant across each gantry span.

(b) For a single span across both directions of travel, a single APE must be calculated using both directions of travel.

(c) The APE is applied separately to each direction of travel for non-accessible span gantries, when a center column is used.

(d) A single APE must be calculated using both directions of travel, for accessible gantries, when a center column is used and the truss elevation must be constant across both gantry spans.

284.1.1.3 Toll Equipment Operation and Maintenance

(1) The toll equipment operation and maintenance must not be compromised by any mounting hardware or gantry element.

(2) Non-accessible gantry elements must allow the J-arms to be located anywhere along the horizontal support pipes.

(3) Non-accessible gantry W-section member spacing must be as follows:

(a) Equipment layout conflicts: Avoid physical conflicts with Toll Equipment layout for all vendors.

(b) Multiple equipped lanes at span gantries: ½ the width of the equipped lane. When equipped lane and shoulder widths under the gantry are not identical, the width of the majority of the equipped lanes and shoulders must be used.

(c) Single lane ramps: Gantry W-section member spacing must be 6 feet.

(d) Truss web angle connection plates: W-section members must not be located in the same longitudinal position with truss web angle connection plates.

(e) W-section members closest to the upright may deviate from the spacing described in (b) and (c) above to ensure there are no conflicts per (a) and (d) above.

(f) W-section members are required where needed to support all longitudinal cable trays along the gantry over equipped and non-equipped lanes.

(4) Accessible gantry swing gate post spacing must be:

(a) Evenly spaced except as noted in item (c) below.

(b) No greater than 6 feet from centerline of post to centerline of post.

(c) Adjusted as necessary to avoid equipment conflicts.

(5) There must be a 5/8-in minimum vertical clearance between any gantry element and any gantry-mounted toll equipment in both operation and maintenance positions. See exhibits from ***SM, V3 19.4.2*** for toll equipment operation and maintenance positions at an accessible gantry.

(6) Field splices must be located to avoid conflicts for all interim and ultimate conditions as follows:

(a) Non-accessible gantry W-section member layout

(b) Accessible gantry equipment retraction assembly inclusive of gate posts, gear box layout, etc.

(7) See ***SM, V3 19.4.3 (3)*** for additional layout requirements for accessible gantries.

284.2 Toll Gantry Structural

See ***Structures Manual, Volume 3, Chapter 19*** for Toll Gantry Structural design criteria. Exhibits supporting this chapter are included in ***FDM Exhibits 284-12*** through ***284-59***.

284.3 Gantry Electrical

284.3.1 General Requirements

Equipment and raceway placement must avoid conflicts with access to all site elements.

284.3.2 Cable Tray

(1) The AVI section of the cable tray must be used for the antenna RF cables.

(2) The data section of the cable tray must be used for data and composite cables rated less than 50V.

(3) The power section of the cable tray must be used for 120V power cabling.

(4) Bond cable trays and metal conduits with grounding bushings and a #10 AWG, minimum bare copper equipment grounding conductor.

(5) The AVI data cable may be routed through either the AVI section or the data section of the cable tray.

(6) See ***FDM 284.3.5*** for non-accessible gantry cable tray requirements.

(7) See ***FDM 284.3.6*** for accessible gantry cable tray requirements.

284.3.3 Wire Troughs

(1) Wire troughs must not be located between the gantry column and the roadside barrier.

(2) All wire troughs must be mounted on galvanized strut channel supports such that the bottom of the enclosure is 4 feet above the concrete slab or sidewalk below, as shown in ***Exhibit 284-60***, except for the AVI wire trough on the AVI reader ground-mounted frame.

(3) Drain fittings must be provided at the bottom of the wire trough as shown in ***Exhibit 284-60***. The drain fittings must maintain the NEMA 3R rating of the wire troughs.

(4) The data and power conduits/wireways must terminate in their respective wire troughs.

(5) The AVI conduits/wireways from the gantry must either terminate into the AVI wire trough or at the AVI reader ground-mounted frame.

(6) Raceways terminating into wire troughs from non-accessible gantries must be in accordance with ***FDM 284.3.5.1***.

(7) Raceways terminating into wire troughs from accessible gantries must be in accordance with ***FDM 284.3.6.4***.

(8) **For TEB Sites:** See ***FDM 283.3.14 (6)*** for conduit termination requirements from the wire troughs to the TEB.

(9) **For RTC Sites**: See ***FDM 282.3.11 (5)*** for conduit termination requirements from the wire troughs to the RTC and OCC.

284.3.3.1 Toll Equipment Building Sites

(1) Non-accessible gantry wire troughs must be rated NEMA 3R and sized 12-inch H x 12-inch W x 24-inch L.

(2) Accessible gantry power wire troughs must be rated NEMA 3R and sized 12-inch H x 12-inch W x 24-inch L.

(3) Accessible gantry data/AVI wire troughs must be rated NEMA 3R and sized 12-inch H x 12-inch W x 96-inch L.

284.3.3.2 Roadside Tolling Cabinet (RTC) Sites

(1) Non-accessible gantry power and AVI wire troughs must be rated NEMA 3R and sized 12-inch H x 12-inch W x 24-inch L.

(2) Single movement sites: Non-accessible gantry data wire troughs must be rated NEMA 3R and sized 12-inch H x 12-inch W x 24-inch L.

(3) Dual movement sites: Non-accessible gantry data wire troughs must be rated NEMA 3R and sized 12-inch H x 12-inch W x 36-inch L.

284.3.4 Lightning Protection

(1) Two grounding studs (lugs) must be installed at the base of each gantry upright for connecting to the lightning protection system.

(2) All ground mounted metallic enclosures, supports, and equipment must be connected to an underground lightning protection system conductor at the base of the gantry foundations by lightning protection bonding conductors.

(3) See ***Exhibit 284-61*** for bonding and grounding of uprights, stair columns and wire troughs.

284.3.5 Non-Accessible Gantry

Conduit, cable tray, AVI reader ground-mounted frames, AVI reader placement in TEBs, AVI reader mounting system on the gantry, lightning protection, duct banks, directional bores, loop pull boxes, and TEB penetrations must be provided as described herein for the connection of the gantry and roadside tolling equipment to the TEB or RTC.

284.3.5.1 Conduit

(1) Vertical conduit from the horizontally mounted cable tray must be located on the gantry upright and terminated into wire troughs at the base of the gantry, except for median cantilever gantries as described in ***FDM 284.3.5.8***.

(2) Conduits must not terminate into the top of the wire trough.

(3) See ***Exhibit 284-13***, ***Exhibit 284-14***, ***Exhibit 284-62***, and ***Exhibit 284-63*** for conduit layout and support requirements.

284.3.5.2 Longitudinal Cable Trays

(1) Provide 5-in high aluminum ladder type cable tray with dividers to separate AVI, data, and power cabling.

(2) Cable tray must be no less than 9 inches wide and no greater than 24 inches wide.

(3) AVI, data, and power sections of the cable tray must be at least 8 inches wide.

(4) Provide waterfall fittings as needed for all cables that transition out of the longitudinal cable trays as shown in ***Exhibit 284-62***, ***Exhibit 284-63***, and ***Exhibit 284-64***.

(5) Extend the longitudinal cable tray to within 12 inches of the end of the upright cable tray below. Longitudinal cable tray must not extend beyond the nearest end of the upright cable tray below.

(6) Cable tray must be supported by strut channel frame as shown in ***Exhibit 284-62*** and ***Exhibit 284-63***. Strut channel must be secured to the gantry structure with beam clamps as shown in ***Exhibit 284-64***.

284.3.5.3 Equipment Cable Tray

(1) Equipment cable tray must be provided to support all cabling between the longitudinal cable tray and the equipment on the J-arms. A galvanized threaded rod assembly for field installation of galvanized strut channel to W-section members must be provided at NEC required spacing. These mechanically fastened assemblies must have galvanized self-locking nuts with washers installed above and below the W-members as shown in ***Exhibit 284-64***.

(2) Equipment cable trays must span along the entire W-section within 12 inches from the centerline of the approach and departure J-arms, except as stated below.

(3) In accordance with ***FDM 284.1.1.3***, VCARs must open for maintenance without conflict. When installation of the equipment cable tray as described in item (2)

above results in impacts to VCAR maintainability, equipment cable tray must terminate 42 inches from the centerline of the applicable J-arm.

284.3.5.4 Upright Cable Tray

(1) An upright cable tray must be provided as a termination point for the vertical conduit installed on the uprights and support cables transitioning to the longitudinal cable trays located on the gantry truss as shown in ***Exhibit 284-62*** and ***Exhibit 284-63***.

(2) Weatherproof blind end covers must be provided on ends of the cable tray.

(3) A factory cable tray with a pitched cover must be provided over the vertical conduit terminations to prevent water intrusion. Extend the cover from the end of the cable tray to at least 18 inches beyond the conduit terminations.

(4) Vertical conduit terminations into the cable trays must be provided with manufacturer supplied fittings.

(5) Vertical conduit installed on the uprights must extend 1 inch above the bottom of the cable tray.

(6) Cable tray must be supported by strut channel frame as shown in ***Exhibit 284-62*** and ***Exhibit 284-63***. Strut channel must be secured to the gantry structure with beam clamps as shown in ***Exhibit 284-64***.

284.3.5.5 AVI Reader Placement in Toll Equipment Building

For toll sites with only one critical power panel and where the cable distances allow, the AVI readers must be wall-mounted inside the associated TEB as shown in ***Exhibit 283-13***.

See ***FDM 283.3.14*** for additional requirements on AVI cable routing for AVI reader placement in the building.

284.3.5.6 AVI Reader Ground-Mounted Frames

(1) AVI reader ground-mounted frames must be used:

(a) At TEB sites when AVI Reader placement in TEBs cannot meet the requirements of ***FDM 284.3.5.5***.

(b) At RTC and TEB sites when antenna to AVI reader cable distance requirements identified in ***FDM 282.5.3 (1)*** can be met.

(2) See ***Exhibit 282-40*** for AVI reader ground-mounted frames.

(3) See ***FDM 283.3.14*** and ***FDM 282.3.11*** for additional requirements on AVI cable routing.

284.3.5.7 AVI Reader Gantry-Mounted Frame

(1) If the AVI readers cannot be placed inside the TEB or on AVI reader ground-mounted frames, mount the AVI readers over a shoulder on the gantry:

(a) Use the inside shoulder for EL-only toll sites.

(b) Use the outside shoulder for all other toll sites.

(c) Mount AVI readers on the departure side where possible.

(2) Provide galvanized strut channels on the non-accessible gantry truss for the TEC to vertically mount each TEC-provided AVI reader fiberglass NEMA 4 enclosure as shown in ***Exhibit 284-65***.

(3) TEC equipment enclosure, AVI reader fiberglass enclosures, and associated elements must not be in conflict with any gantry elements supporting interim and ultimate lanes.

(4) See ***FDM 283.3.14*** and ***FDM 282.3.11*** for additional requirements on AVI cable routing.

284.3.5.8 Cantilever Gantry Mounted on Median Barrier

(1) Each vertical conduit from the horizontally mounted cable tray must terminate in a vertically-mounted handhole (pencil pull box). The conduit and pencil pull box supports must be designed such that they do not conflict with the gantry upright stiffener plates. See ***Exhibit 284-66*** for additional requirements.

(2) Cantilever gantries must be designed according to the requirements for typical non-accessible span gantries with the following exceptions:

(a) The 3-in power and data conduits routing below the median must be located a minimum of 5 feet away from the 1-in roadway pavement loop conduits.

(b) Conduits on the upright consists of three 3-inch RGS conduits for data and one 3-in RGS conduit for power extending from the upright cable tray above.

(c) When the toll loop pavement area is located on the same side as the TEB, the CCTV, data and power conduits must route to separate pull

boxes for cantilever data, and cantilever power, located in the median barrier as shown in ***Exhibit 282.32***.

(d) When the toll loop pavement area is located on the opposite side from the TEB, the CCTV, data and power conduits must route directly to separate pull boxes for cantilever data, and cantilever power, located adjacent to the TEB. See ***Exhibit 282-23*** for dual movement example.

(e) When the RTC site serves a single movement median cantilever gantry, the CCTV, data and power conduits must route to the OCC as shown in ***Exhibit 282-26*** and ***Exhibit 282-32***.

(f) When the RTC site serves dual movement median cantilever gantries, the CCTV, data and power conduits must route to the OCC associated with each gantry as shown in ***Exhibit 282-25*** and ***Exhibit 282-29***.

(3) A non-accessible span gantry may be considered to satisfy cable distance requirements from ***FDM 282.5***.

284.3.5.9 Cantilever Gantry Mounted Behind Concrete Barrier

Cantilever gantries electrical must be designed according to the requirements for typical non-accessible span gantries when the cantilever gantry is mounted behind the concrete barrier.

284.3.6 Accessible Gantry

284.3.6.1 General Requirements

(1) The following elements must be provided as part of the accessible gantry electrical layout:

(a) CCTV infrastructure

(b) Maintenance receptacles

(c) Cable trays

(d) TEC equipment enclosure and AVI reader mounting assemblies

(e) Wireways and associated strut channel supports

(f) Lighting control

(g) Lighting for platform and stairway

(2) See ***Exhibit 284-67*** for details of the electrical infrastructure of the accessible gantry.

(3) The 120 VAC branch circuits serving power outlets, lighting, or equipment on the gantry must be installed in the power section of the cable tray from panel EDP.

(4) Transverse cable trays must be provided connecting the power outlets, lighting and toll equipment conductors to the power cable tray on the gantry as shown in ***Exhibit 284-69***.

(5) A minimum of one (1) maintenance receptacle must be provided per direction of travel. Additional receptacles are required along the gantry at maximum longitudinal spacing of 100 feet.

(a) See ***Exhibit 284-69*** for the two types of receptacle mounting details.

(b) Cables above the upper grating must be installed in conduits with CGB fittings for cable strain relief.

(6) Lighting fixtures must not be mounted on moveable swing gates or associated swing gate posts.

(7) Lighting and associated infrastructure must not impede the swing gates' operational requirements that allow toll equipment to be rotated to the maintenance position.

284.3.6.2 Cable Trays

(1) The following cable trays must be provided along the entire horizontal section(s) of the gantry as shown in ***Exhibit 284-68***:

(a) A minimum of two (2) 24-in wide aluminum ladder type cable trays for data/AVI.

(b) A minimum of two (2) 6-in wide aluminum ladder type cable trays for power.

(2) Cables installed in cable trays must be UL or other NRTL listed and rated as "Tray Cable (TC) Rated".

(3) The data/AVI cable trays must be used to route data cabling for tolling cameras, illuminators, TEC equipment, AVI cables, and antenna RF cables.

(4) A 6-in wide channel type transverse power cable trays must be used to route 120 VAC power cabling for TEC equipment, maintenance receptacles, gantry lighting, and gantry walkway lighting. See ***Exhibit 284-69*** for additional requirements.

284.3.6.3 AVI Reader Accessible Gantry-Mounted Frame

(1) The positioning of each AVI reader fiberglass enclosure and TEC equipment enclosure on the accessible gantry and the adjacent light fixtures, receptacles, switches, etc. must be as shown in ***Exhibit 284-70***, and ***Exhibit 284-72***.

(2) AVI reader fiberglass enclosures, TEC equipment enclosure, associated elements, strut channel, and mounting plates must not be located on the moveable swing gates or where swing gate elements would conflict with AVI reader enclosure access and associated light fixtures.

(3) AVI reader and TEC equipment enclosure mounting locations must not interfere with future toll equipment arm assemblies for existing or future lanes.

(4) A galvanized strut channel must be provided on the accessible gantry maintenance walkway at AVI reader and TEC equipment enclosure mounting locations as shown in ***Exhibit 284-70***. The element is used by the TEC to vertically mount each TEC-provided AVI reader fiberglass NEMA 4 enclosure and TEC equipment enclosure to the accessible gantry structure.

284.3.6.4 Wireway Transition to Wire Troughs

(1) The horizontal cable tray sections along the gantry truss must terminate in a minimum of seven (7) 6-in x 6-in fiberglass wireways dual rated NEMA 12/3R.

(2) The fiberglass wireways must run horizontally on the truss prior to descending the gantry upright as shown in ***Exhibit 284-72*** and ***Exhibit 284-74***.

(3) The horizontal ends of the wireways must be protected from stormwater intrusion as shown in ***Exhibit 284-72*** and ***Exhibit 284-73***.

(4) The wireways must descend on the column located on the TEB side of the roadway and terminate in their respective NEMA 3R wire troughs as shown in ***Exhibit 284-71*** and ***Exhibit 284-74***. Wireways must not terminate into the top of the wire trough.

(5) Drain fittings must be provided at the bottom vertical to horizontal transition prior to wire trough termination as shown in ***Exhibit 284-74***. The drain fitting must maintain the NEMA 12/3R rating of the wireways.

(6) All wireways must be routed and supported with galvanized strut channels as they descend the gantry upright as shown in ***Exhibit 284-74***.

284.3.6.5 Lighting for Platform and Stairway

(1) LED rope light must be used along the full perimeter of the accessible gantry platform as shown in ***Exhibit 284-67*** and ***Exhibit 284-72***. See ***Exhibit 284-75*** for rope lighting mounting details.

(2) AVI reader area lighting must be provided on either side of the AVI reader mounting assembly as shown in ***Exhibit 284-70***.

(3) Stair and platform luminaire must be the same as specified for the TEB exterior walls without the photocell accessory. This fixture must be affixed to the stair rail and the non-moveable portion of the swing gate structural system as shown in ***Exhibit 284-76***.

(4) Timer switches must be provided at the lower platform and upper platform to independently control the lighting for the stairs, AVI reader area lighting, and rope lighting. See ***Exhibit 284-67***, ***Exhibit 284-72***, and ***Exhibit 284-76*** for timer switch locations.

284.3.7 CCTV System

(1) See ***FDM 282.3.9*** for site-wide CCTV requirements.

(2) See ***Exhibit 282-41*** and ***Exhibit 282-42*** for location of gantry mounted CCTV cameras.

(3) Gantry column CCTV cameras must be mounted 12 feet above finished grade for non-accessible gantries. See ***Exhibit 284-77*** for detailed mounting requirements.

(4) Location of accessible gantry mounted CCTV cameras 7, 8, 9, and 10 must be coordinated to avoid conflicts with gate operations and J-arm retraction systems. See ***Exhibit 282-41*** for quantity and layout of boxes to support the CCTV cameras.