

Chapter 28

Shop and Erection Drawings

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Chapter 28

Shop and Erection Drawings

28.1 Introduction

Shop Drawings include all drawings, diagrams, illustrations, schedules, catalog data, material certifications, fabrication procedures, storage and/or transportation procedures, test results, design calculations, etc., required by the Contract Plans and Specifications and submitted by the Contractor to define some portion of the project work. While the Contract Plans and Specifications (including Supplemental and Special Provisions) define the overall nature of the project with many specific requirements, Shop Drawings provide a method for the Contractor to propose, under specification guides and for the Department to approve or reject, a particular material, product or system of accomplishing the work. Each Contractor knows best what materials and equipment can be provided more expeditiously and economically and, if an item proposed meets the contract requirements, the submission of Shop Drawings is the accepted method of approving an element of the structure while allowing flexibility in the Contractor's choice of materials and construction techniques.

It is mandatory, however, that Shop Drawings not be used to modify the construction contract time, the contract amount, the design intent nor in any way reduce the maintainability, structural integrity or load-carrying capacity of the structure or its components. Such modifications can only be administered by revised plan sheets or specifications.

Erection Drawings include all drawings, diagrams, design calculations, procedure manuals and other data required to depict in detail the proposed assembly and methods of installation of components into the project work. The work of construction is the expertise of the Contractor, who should be allowed some latitude in the use of construction means, methods, techniques, sequences and procedures as are compatible with and will result in the project being completed in accordance with the requirements of the Contract Plans and Specifications. Shop Drawings for items such as steel girders, precast/prestressed beams, miscellaneous steel, etc., usually include plan views and/or elevation views denoting the correct placement of a component in the structure. Additional Erection Drawings are required for major structures for items such as special precasting, handling and erection equipment, or the erection of concrete segmental bridges. The Engineer of Record must ensure that the Contract Plans and Special Provisions for the project clearly define all requirements for submittal of Erection Drawings.

The following are definitions used herein:

1. **Engineer:** As defined in *FDOT Standard Specifications for Road and Bridge Construction, Section 1*.
2. **Engineer of Record:** As defined in the *FDOT Standard Specifications for Road and Bridge Construction, Section 1*.
3. **Specialty Engineer:** As defined in the *FDOT Standard Specifications for Road and Bridge Construction, Section 1*.
4. **Consultant:** The Professional Engineer or Engineering Firm, or the Architect or Architectural Firm, licensed in the State of Florida and under contract to the Department to perform professional services. The consultant may be the Engineer or Architect of Record or may provide services through and be subcontracted to the Engineer or Architect of Record.
5. **Resident Engineer:** The Department's local area representative who reports directly to the District Construction Engineer and may be either a Departmental employee of the District or an employee of an engineering firm which is also serving as the Department's CEI (Construction Engineering and Inspection) Group. The Resident Engineer is the principal representative of the Department for a project at the District level. It shall be noted that neither the Resident Engineer nor the CEI Group is involved with the Shop/Erection Drawing review process but are recipients, only, of approved Shop/Erection Drawings.
6. **Architect of Record:** The Architect or Architectural Firm registered in the State of Florida that performs services for the Department in connection with the design and construction of buildings.
7. **"Ballooning":** The contractor's use of minimum 1/16 inch wide lines to "balloon" or "cloud" (encircle) notes or details on drawings, design calculations, etc., in order to explicitly and prominently call out any deviations from the Contract Plans or Specifications. The Engineer of Record may also use "ballooning" to make note of any limitations to their submittal review and disposition of shop and erection drawings.
8. **Record Shop Drawings:** The Department's official record copy of all Shop drawings, Erection Drawings, calculations, manuals, correspondence/ transmittal files and submittal activity record (logbook).
9. **Department Review Office:** The office or other Department entity responsible for performing the Department's review, record keeping, disposition and distribution of Shop and Erection Drawings.
10. **Final Review Office:** The Department Review Office or the Engineer of Record performing the final review and making final distribution of shop drawings which have been reviewed.

28.2 Drawing Submittals Required

Generally, Shop Drawings shall be required for items which require fabrication at a location other than the project job site.

Unless otherwise noted in the Special Provisions for the project, Shop Drawings are not required for reinforcing steel for cast-in-place concrete which is completely detailed and listed on the Contract Plans or on the Department's Standard Index Drawings. A copy of reinforcing bar lists shall be forwarded by the Contractor to the Department's Resident Engineer for record purposes.

Components such as traffic signal equipment, steel or aluminum light poles, concrete strain poles and high mast lighting may not require submittal of Shop Drawings due to having prior certification by the Department. The Contractor may contact the Department's Resident Engineer or the appropriate Department Review Office for clarification of any item.

Material certifications are typically submitted by the Contractor to the Resident Engineer whom forwards the certifications to the State Materials Engineer in Gainesville.

Except as otherwise stipulated in the Specifications, precast and/or prestressed concrete items other than those constructed from standard drawings require the submission of Shop Drawings.

Shop Drawing submittals for structural steel shall include complete shop and field details including a bill of materials, all dimensions, bolt and hole sizes, camber diagrams, web cutting diagrams, weld symbols, surface preparation and shop paint.

In general, drawing submittals for any item shall follow industry standards in regard to the quantity and quality of information contained. As a minimum, the information shown on approved shop drawings should be complete enough to allow for fabrication of the item without referencing any other document. The Department shall expect submittals to meet or exceed the quality level of previously approved submittals of a similar nature.

During component fabrication and construction phases of the project, the Contractor may elect to submit to the Engineer, for consideration or approval, repair procedures or disposition requests due to errors or omissions in the work. The information required and the procedure to be followed by the Contractor in initiating such requests shall be in accordance with the FDOT **Specifications** or as determined by the Engineer.

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28.3 Contractor Information Required

All Shop Drawings and Erection Drawings shall contain the following minimum information: the complete Financial Project Identification, drawing number, drawing title, a title block showing the name of the fabricator or producer and the Contractor for which the work is being done, the initials of the person(s) responsible for the drawing, and the date on which the work was performed.

The drawing shall also contain, adjacent to the title block, information which describes the location of the item(s) within the project. This information may consist of the Contract Drawing number, the station at which the item is positioned (as may be the case for sign structures or handrails), or the Site at which it is to be installed.

Before submission of each drawing, the Contractor shall have determined and verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto, and shall have reviewed and coordinated each drawing with other Shop Drawings and with the requirements of the Contract Plans and Specifications. The Contractor shall have stamped and initialed each sheet giving specific written indication of compliance with the above described specific responsibilities with respect to review of the submission.

The Contractor's approval signifies that the submittal meets the requirements of the Contract Plans and Specifications and conforms to field dimensions or other potential deviations from the established project documents. Drawing submittals received without stamping by the Contractor shall be returned for resubmittal.

At the time of each submission, the Contractor shall have given specific written notice (as in the transmittal letter) of each variation the Shop/Erection Drawings may have from the requirements of the Contract Plans and Specifications. In addition, the drawings shall contain a specific notation which explicitly and prominently calls out any deviation. Approval of Shop/Erection Drawings will not constitute nor be considered grounds for approval of a variation in which the project requirements are affected unless specifically so noted in the Department's approval comments as returned with the drawing submittal.

28.4 Submittals Requiring a Specialty Engineer

In general, and when so permitted in the Specifications, if a Shop/Erection Drawing submittal reflects any changes in the design and/or details of the Contract Plans, the Contractor shall have had a Specialty Engineer seal one (1) print of each drawing affected as well as the cover sheet of one (1) copy of any design calculations required. The Contract Plans and Specifications (including Supplemental and Special Provisions) shall contain instructions regarding requirements of a Specialty Engineer for items such as concrete segmental bridge work, loads imposed on an existing structure, or certain construction procedures and/or equipment.

Submittals which introduce engineering input to the project, such as defining the configuration or structural capacity of prefabricated components or assemblies not contained in the Contract Plans, shall require the services of a Specialty Engineer. Drawings prepared solely as a guide for component fabrication/ installation and requiring no engineering input, such as reinforcing steel drawings and catalog information on standard products, do not require the use of a Specialty Engineer.

When required, the Specialty Engineer shall properly seal on one (1) record print of each drawing and the cover sheet of one (1) record copy of calculations or computer printouts. Computer printouts are an acceptable substitute for manual computations provided they are accompanied by sufficient documentation of design assumptions and identified input and output information to permit their proper evaluation. Such information shall bear the seal of the Specialty Engineer as verification that he or she has accepted responsibility for the results.

It is emphasized that a Specialty Engineer may not affix his seal to any item not prepared under his direct supervision and control.

When a submittal requires a Specialty Engineer, the sealed prints and calculations will ultimately be retained by the Department, as the official, record Shop Drawing. See also Transmittal of Submittals hereinafter.

28.5 Scheduling of Submittals

Review of the submittal requirements and procedures at the outset of the construction contract is of benefit both to the Contractor and the Department. Therefore, the Contractor may have been requested by the Department to provide a Working Schedule for Shop/Erection Drawing submittals.

The preparation of a Working Schedule will bring to the attention of the Contractor the number of submittals required and at times may denote items about which the Contractor may wish the Department's advice as to the manner in which the design is to be implemented. Adherence to the Working Schedule will make for a smoother working relationship between all parties involved in the project, and proper planning should reduce the possibility of a large number of submittals being forwarded for review concurrently.

The Contractor is generally required to schedule submissions such that a minimum of 45 calendar days is allowed for review by the Department for routine work of which the first 30 calendar days are allotted to prime review by the Engineer of Record. However, for most routine submittals, a time period of 14 to 21 calendar days should be adequate. For work of more complexity, the review time may be adjusted proportionately to the complexity of the work. Allowance must also be made for potential resubmittals, and the Contractor normally is advised by the Department to consider a 75 to 90 calendar days total lead-time for submittals prior to the need for fabrication or construction work.

The Contractor must make submittals for approval with such promptness as to cause no delay in his fabrication and construction schedules. Only in emergency cases should special consideration be requested. If a submittal requires resubmission, an approximate additional 30 calendar days should have been scheduled by the contractor for approval of the resubmittal of which the first 15 calendar days are allotted to prime review by the Engineer of Record.

28.6 Transmittal of Submittals

Submittal of Shop/Erection Drawings shall be made to the designated office, as applicable, only by the Contractor for the project. In that the Department's legal contracts and documents are with the Contractor, submittals shall not be accepted directly from a subcontractor or fabricator. Situations may occur when a subcontractor or fabricator is allowed to make an advance submittal for review; however, the actual submittal to be stamped and approved must follow from the Contractor with the Contractor's stamp. Subcontractors and fabricators are encouraged to contact the appropriate Department Review Office for guidance or advice at any time. **Exhibits 28-A** thru **28-C** show the flow of submittals during the review process. All transmittals of submittals between parties shall be accomplished by OVERNIGHT DELIVERY.

The Special Provisions for the project may denote the amount of drawings, etc. to be submitted and the procedure to be followed. Furthermore, the office to which the Contractor shall transmit his submittal and the procedure to be followed may also be defined during the preconstruction conference for the project. In the absence of such instructions, the following generally applies:

28.6.1 General Submittal Requirements

On projects where the Engineer of Record is a Consultant to the Department, and unless otherwise directed at the project's preconstruction conference, the Contractor shall have submitted two (2) sets of xerographic reproduces directly to the consulting Engineer of Record. On projects where the Department is the Engineer of Record, the Contractor shall have submitted two (2) sets of xerographic reproduces directly to the appropriate Department Review Office. For design calculations, four (4) complete sets, including computer printouts, shall be submitted with the drawings. All drawings shall be on sheets not larger than 11" x 17". The Contractor's letter of transmittal should always accompany the drawings and a copy should always have been sent to the Department's Resident Engineer. On those projects where the Engineer of Record is a Consultant to the Department, and the Department will be reviewing the shop drawings, a second copy of the Contractor's letter should also have been sent to the Department's Review Office.

28.6.2 Requirements for Department EOR

On projects where the Engineer of Record is Department in-house staff, submittals shall have been transmitted to the appropriate Department Review Office as directed at the project's preconstruction conference. The Department's Review Office is the principal contact group and "clearing house" for all construction submittals and information desired by the Contractor regarding structural, mechanical or electrical items.

28.6.3 Requirements for Consultant EOR (Full Services)

28.6.3.1 Review by Engineer of Record only

On projects where the Engineer of Record is a Consultant to the Department and has been retained by the Department to review construction items without follow-up review by the Department, the Consultant will assume the responsibility of the owner's agent. The reviewing consultant is encouraged to communicate with fabricators, contractors, specialty engineers and the Department's Structures Office to clarify concerns before returning the submittal to the contractor. The reviewing consultant shall also contact the Department's Structures Office if unsure of the Department's position on certain issues during the review. Submittals should not be stamped "resubmit" if "approved as noted" will suffice. Submittals (unless otherwise noted below) shall have been transmitted by the Contractor directly to the Consultant. Upon receipt of the submittal, the Consultant shall perform the review, note any comments directly on the sheets, make the appropriate numbers of copies, indicate his disposition by stamping the sheets as described hereinafter, retain one set of prints for his files and, finally, make distribution as described hereinafter. The original prints and calculations form the official, record Shop Drawing submittal and must be retained by the Engineer of Record and forwarded to the Department at the end of the project.

28.6.3.2 Review by Engineer of Record and the Department

On projects where the Engineer of Record is a Consultant to the Department and has been retained by the Department to review construction items, submittals (unless otherwise noted below) shall have been transmitted by the Contractor directly to the Consultant. Upon receipt of the submittal, the Consultant shall perform the review, note any comments directly on the sheets, indicate his disposition by stamping the sheets as described hereinafter, retain one set of prints for his files and, finally, transmit the original sheets to the Department's Review Office for review and distribution. When submittals require a Specialty Engineer, the original prints and calculations form the official, record Shop Drawing submittal and must be retained by the Department. Upon completion of his review, the Consultant shall transfer his comments to the sealed sheets, indicate his disposition and transmit them to the Department as described above.

28.6.4 Requirements for Consultant EOR (Design Services Only)

On projects where the Engineer of Record is a Consultant to the Department but has not been retained by the Department to review construction items, submittals (unless otherwise noted below) shall have been transmitted by the Contractor directly to the Department's Review Office as directed at the project's preconstruction conference.

28.6.5 Requirements for Architectural or Building Structures

Submittals related to Architectural or Building Structures, such as Rest Areas, Picnic Pavilions, Offices and Warehouses, shall be made according to the requirements of the Architectural Services Group, Production Support Office, Florida Department of Transportation, 605 Suwannee Street, MS 40, Tallahassee, FL 32399-0450, Phone (850) 414-4378.

28.6.6 Requirements for Roadway Submittal Items

All submittals related to roadway plans such as lighting, attenuators, retained earth systems, etc. (except bridge items such as poles and bracket arms, or as noted below) shall be distributed in accordance with the ***Construction Project Administration Manual (Topic No. 700-000-000)*** for the component involved or as otherwise directed at the project's preconstruction conference. Submittals related to bridge items shall have been transmitted to the Department as previously described in this section.

28.6.7 Requirements for Overhead Sign Structures and Nonstandard Miscellaneous Structures

Submittals concerning overhead sign structures shall have been transmitted in accordance with the General and Structures Requirements above.

28.6.8 Miscellaneous Requirements and Assistance

For items not specified above or for which questions may arise as to submittal requirements, the Contractor should be advised to contact the appropriate Department Review Office. For submittals of any type, the Contractor shall always have transmitted a copy of the letter of transmittal to the Resident Engineer.

28.7 Disposition of Submittals

The approval or disapproval of submittals by the Reviewer shall be indicated by one of the following designations: "APPROVED" (no further action required), "APPROVED AS NOTED" (make corrections noted - no further submittal required), "RESUBMIT" (make corrections noted and resubmit for approval), or "NOT APPROVED" (rejected - do not resubmit the concept or component as submitted).

The disposition designation shall be indicated on each and every drawing sheet, or on the cover sheet of calculations, by the use of a red ink stamp. The stamp size shall not exceed 3" high by 3" wide, but 1 ½" high by 3" wide stamp is preferred. Stamps shall identify the approving groups, such as the Engineer of Record - Consultant, the Department's assigned commercial inspection agency and/or Department personnel, and the date. All notations or corrections made on the approval prints shall be consistently marked on all drawings.

All Consultants reviewing submittals shall red ink stamp and initial each item as noted above with the firm's appropriate stamp. Consultants must declare any limitations to the extent of their review and approval by the terminology of their standard stamp and/or by additional written and "ballooned" notes on the submittal items. When the Engineer of Record is a Consultant, and when he or she retains a Subconsultant to assist in the submittal review, the Engineer of Record shall signify disposition of the submittal as noted above with his firm's appropriate stamp prior to distribution or prior to transmitting it by overnight delivery to the Department. In this event it is the Engineer of Record's prerogative to also require a disposition stamp by his Subconsultant.

When a submittal contains deviations from the Contract Plans and Specifications, the Consultant and the Department shall determine as to whether or not a Supplemental Agreement or Value Engineering Change Proposal (VECP) is required. If either procedure is required to be initiated, the submittal shall not be reviewed until a decision is finalized.

When the Engineer of Record receives a submittal that is not in accordance with the requirements of this chapter, the Contractor shall be advised to resubmit immediately with the corrections or additions necessary.

Review and approval by the Engineer of Record (Consultant and/or Department) shall be for conformance with the design concept of the project and for compliance with the information given in the Contract Plans and Specifications (including Supplemental and Special Provisions). The review and approval shall not extend to means, methods, techniques, sequences or procedures of construction (except where a specific means,

method, technique, sequence or procedure of construction is indicated in or required by the Contract Plans and Specifications) or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

Disposition of Shop Drawing submittals by the Engineer of Record for construction and erection equipment including beams and winches, launch gantry, erection trusses, forms, falsework, midspan and/or longitudinal closures, lifting devices, temporary bearing fixity devices, cranes, form travelers, segment carrying equipment and stability devices shall be either "NOT APPROVED" if deemed to be unacceptable or, if acceptable, shall be "APPROVED AS NOTED" with the following note included on the submittal drawings:

"Drawings are acceptable for coordination with, relationship to, and effects upon the permanent bridge; but have not been reviewed for self-adequacy. Adequacy and intended function remain the sole responsibility of the Contractor."

Unless otherwise specifically designated in a Consultant's Scope of Services or required by the Department, the Engineer of Record is not responsible for accepting or reviewing calculations or drawings pertaining to construction formwork. These documents should normally have been submitted to the Resident Engineer or, in the event they are erroneously transmitted to the Engineer of Record, should be immediately rerouted to the Resident Engineer.

On projects when the Engineer of Record is a Consultant to the Department and the Department will also be reviewing shop drawings the Department will perform a second, confirmation review of the submittal upon receipt of the Consultants transmittal of reviewed drawings which have been stamped for disposition as noted above. The primary purposes of the Department's review include: conformance with FDOT policy, standards, etc.; uniformity of disposition with similar submittals; accuracy and completeness of the Consultant's review; and attention to specific details, areas of work, etc. that have experienced recurring problems during fabrication and/or construction.

When the Specialty Engineer is required by the Contract Plans and specifications to perform a portion of the design of the project, the Engineer of Record shall confirm that:

1. The Specialty Engineer is qualified to design and prepare the submittal.
2. The specified number of submittals have been furnished.
3. A minimum of one (1) set of Shop Drawings and the cover sheet of one (1) set of calculations have been correctly sealed by the Specialty Engineer.

4. The Specialty Engineer has understood the intent of the design and has used the correct specified criteria.
5. The configuration set forth in the submittal is consistent with that of the Contract Documents.
6. The Specialty Engineer's methods, assumptions and approach to the design are in keeping with accepted engineering practices.
7. The Specialty Engineer's design does not contain any gross inadequacies that would jeopardize or threaten public safety.

A detailed review of design calculations is not required, and a detailed review of dimensions (other than at interface areas with other work) is not required.

When a submittal has been returned as "RESUBMIT", the Contractor shall have made corrections as required and shall have returned the required number of corrected copies for review. All revisions to a drawing, etc., shall have been noted with a symbol consisting of the revision number within a triangle located next to revised area. The Contractor must have directed specific attention in writing to revisions other than the corrections called for by the Department on previous submittals.

Exhibits 28-A thru **28-C** show the submittal and distributional flow of a shop drawing transmittal. When the Department concurs with the Consultant's review and disposition of the submittal, the Department will stamp and distribute the submittal including a record copy for the Consultant. Should the Department's review and/or disposition of the submittal differ from that of the Consultant, the final disposition of the submittal will be resolved in accordance with the following procedures:

28.7.1 Minor Modifications

The submittal will be processed when notations not involving design decisions are added, modified or deleted and when the disposition of the submittal remains unchanged or changed only in accordance with the following **Table 28.1**:

Table 28.1 FDOT Changes to Minor Modifications

From	To
Approved	Approved as Noted
Approved as Noted	Approved
Resubmit	Not Approved
Not Approved	Resubmit

In this event, the Department will notify the Consultant of the modifications, document the notification in the project's shop drawing file, process and distribute the submittal and furnish the Consultant with a record copy.

28.7.2 Major Modifications

The submittal will be returned to the Consultant for re-review when notations involving significant design decisions must be added, deleted or modified, when the submittal's review is deemed by the Department to be incomplete or require significantly more work or when the disposition of the submittal requires one of the following **Table 28.2**:

Table 28.2 FDOT Changes to Major Modifications

From	To
Approved or Approved as Noted	Not Approved or Resubmit
Not Approved or Resubmit	Approved or Approved as Noted

As above, the Department will notify the Consultant and document the notification. The submittal will be returned to the Consultant for re-review and return to the Department.

28.8 Segmental Bridges - Shop Drawing Checklist

The following list is for guidance only. There may be occasions when particular details and needs are more or less than this list:

28.8.1 Construction Methods and Sequence (Overall Scheme)

This should be the first submittal as it lays out the Contractor's philosophy and overall approach to the project. It should cover:

1. Overall construction schedule (program) for the duration of the contract. Milestone dates should be clearly shown - for example, the need to open a structure by a certain time for traffic operations.
2. Overall construction sequence. The order in which each of the structures is to be built and the sequence in which individual spans or cantilevers are constructed.
3. The general location of any physical obstacles to construction that might impose restraints to the sequence and an outline of how the Contractor intends to avoid or handle such obstacles as he or she builds the structure. Obstacles might include road and rail clearances, temporary diversions, transmission lines, pipelines, local property rights, etc.
4. The general location of any temporary construction obstacles and how these are to be handled. Such might include excavation or cofferdams for an adjacent structure, piling rig or other plant clearances, temporary haul road clearances, etc.
5. The appropriate location of any temporary stability towers or other falsework.
6. The approximate location of any special lifting equipment in relation to the structure including clearances required for operation of that equipment; i.e., crane positions and operating radii.
7. The conceptual position of any special construction devices such as launching girders, support trusses, pier brackets, stability devices, beam, and winch type equipment, etc. (with outline details only at this time) of how the Contractor intends to attach such equipment to the structure. (The precise details of such attachments would be covered under later detailed submittals).
8. Outline proposals for the lifting, handling and storage of segments. (Again, precise details and any extra reinforcement provisions, etc. would be covered under later detailed submittals.)
9. Any other information pertinent to the Contractor's scheme at this time.

The above information should be in as concise form as possible on one or two drawings. The intent is to provide an overall integrated picture of the Contractor's intentions. As such, these drawings are for information only and it should be made quite clear that the delivery and receipt of such drawings does not constitute approval to the details implied therein. They are to be accepted for information only and not approved. However, the Contractor's subsequent detailed submittals should comply with the overall concepts.

28.8.2 Casting Curves and Geometry Control

Casting curves contain the superstructure geometry and compensations for deflections arising as a result of the construction sequence, methods, temporary loads, temporary supports, creep and shrinkage, etc. Camber diagrams are only the deflection compensation portions of the casting curves. Casting curves and camber diagrams may be presented in numerically tabular or graphic forms. The format is not critical, but the information given should be clear and concise, leaving no room for doubt or misinterpretation. Examples and illustrations should be shown to help clarify the data presented. Casting curves and camber should be generated according to the Contractor's proposed methods, sequence, schedule and equipment of the overall scheme. Changes to his overall scheme might require recomputation and submittal of new casting curves and camber.

Geometry control is the process of making field observations and measurements in the casting cell and combining these with the theoretical casting curve data to produce the required structural shape, segment by segment. It involves accurate instrument work and geometry calculations using graphical or computerized methods.

It is normal practice for the geometry control system to be explained in a manual prepared by or on behalf of the Contractor.

28.8.3 Post-Tensioning System and Computation

Contractors usually sublet this work to specialty suppliers. There are some differences of detail between suppliers but, by and large, these are not significant. Usually the differences are only in the shape and size of anchorage devices and jacks for a given tendon size and load.

Only pre-approved post-tensioning systems are to be used by the contractors. The State Structures Design Office (SDO) is responsible for approving these systems. Post-tensioning hardware shop drawings for a particular project should be checked against the drawings on the SDO website to assure the system components are identical to those of the appropriate approved system. The SDO is not responsible to check shop drawings that relate to the use of the approved hardware.

The Post-Tensioning proposals should show and be checked for:

1. Complete details of the pre-approved post-tensioning hardware.
2. Jack sizes and required clearances.
3. Special jack handling devices with all necessary inserts or fixtures.
4. Proposals for threading of tendons (i.e., use of steel wire pulling socks, welded pulling eyes, etc.).
5. Proposals for cutting off strand which has been affected by any heat from welding.
6. Proposals for cutting of surplus strand prior to and after stressing.
7. Information on the jacking equipment, pumps and dial gauges, etc.
8. The storage of materials and protection from corrosion.
9. Assumptions for the stressing operation, coefficient of friction, wobble factor, elastic modulus or stress - strain curve, anchorage draw-in (wedge set), etc.
10. A summary of the jacking loads, tendon forces, and extensions, before and after seating the wedges.
11. A stressing sequence and schedule for groups of tendons.
12. Post-tensioning duct profiles, vent locations, grout injection port locations and geometric layout used in the computations.
13. Proposed recording sheets.
14. Details, sequence, schedule, operations and stressing forces for any temporary post-tensioning.

15. Any special requirements for bursting rebar or extra rebar to restrain radial forces if the profiles are different from those shown in the contract plans.
16. Details for the means of securing the anchorage hardware in position until the concrete has been cast.
17. Details for the splicing of ducts to ensure that a smooth profile is maintained and that any connections are grout-tight.
18. Details of any special bar or tendon couplers such as those to show adequate clearance for couplers when the tendon elongates with stressing, etc.
19. Details for post-tensioning duct supports with regard to strength and frequency to maintain a good profile during concreting.
20. Details of grout joints such as the locations at all high points and at sufficiently close spacing to ensure a good grouting operation.
21. Information on proposed grouting procedures such as grout mix including admixtures, grout pump and delivery system, sequence of grouting (work "uphill" in one direction along a tendon), backup facilities, grouting pressures, etc.
22. Details of anchorage inspection, duct inspection, tendon and anchorage void repairs, anchorage protection systems, deck penetration repairs, etc.

The post-tensioning supplier might not be responsible for all of the above information. Some of it, particularly that relating to rebar, hardware, ducts, vents, etc. should be covered on the segment detail shop drawings. Also, the grouting operation (Item "U") might be by a separate subcontractor. Nevertheless, the Contractor is responsible for coordinating all this activity and for making sure that all the information and details are integrated. It should be noted that several items are more for the benefit of field personnel than part of the shop drawing review.

28.8.4 Segment Shop Drawings

The main purpose of these drawings is to bring all the information together in a format from which the parts can be easily assembled. This involves the integration of diverse details from many areas. Typically the following should be checked:

1. Segment number and direction of erection.
2. All dimensions including widths, lengths, thicknesses, tapers, fillets, radii, working points, post-tensioning duct locations and profiles, clearances, rebar spacings, blockouts, positions of embedded items, holes, grout, vents, anchorage positions and orientations.
3. All reinforcement including bar sizes, shapes, locations, spacings, covers, clearances for the largest sized aggregate, clearances for cumulative tolerances on bending and fixing dimensions, avoidance of conflicts with post-tensioning ducts, anchorages and hardware including any special lifting or equipment connections. As a general rule, rebar should be adjusted to avoid post-tensioning and other important embedments.
4. Clearances for post-tensioning jacks, including temporary post-tensioning bar jacks. Make sure there is enough room to thread a jack onto a post-tensioning tendon remembering that most center hole jacks require 3 to 5 feet of strand projecting out beyond the anchorage. Likewise with bar tendons, especially in blockouts, there has to be room for the jack to be placed over and threaded onto the extended section of bar beyond its anchorage.
5. Clearances for lifting devices. Check that there is room to place anchor plates and nuts on the bottom side of any bars connecting through the slabs to a lifting device, etc.
6. Anchorage and Buttress Detail. Check that there is adequate rebar in these zones for any bursting and local radial forces. This should be covered on the design drawings but might have to be modified as a result of the Contractor's choice of post-tensioning system. The rebar should not cause congestion and there should be adequate spacing for concrete placement and compaction.
7. Casting of blockouts regarding material to be used, reinforcing to be extended from the segments, and time of casting in relation to erection stressing, etc.

28.8.5 Erection Equipment

These drawings should be reviewed for procedure and structural effect on the structure. The shop and erection drawings shall be prepared by the Contractor's Specialty Engineer and will be reviewed as described in **Sections 28.4** and **28.7** of this chapter.

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28.9 Distribution of Submittals

If the initial review and approval of a submittal is performed by a Consultant to the Department, and the Department will be reviewing the shop drawings, the Consultant shall retain one (1) set of materials for his files and transmit the prints (or other sets of calculations or multiple sets of prints) to the Department's Review Office.

Distribution by overnight delivery is made in accordance with the following **Table 28.3**:

Table 28.3 Shop Drawing Distribution Schedule

DISTRIBUTION	FDOT - EOR	Consultant – EOR With Department Review	Consultant – EOR Without Department Review
FDOT Shop Drawing Review Office File	1 Set Original Prints + 1 Set Calcs	1 Set Original Prints + 1 Set Calcs	1 Set Prints + 1 Set Calcs
Engineer of Record	N/A	1 Set Prints + 1 Set Calcs	1 Set Original Prints + 1 Set Prints + 1 Set Calcs
FDOT Resident Engineer	2 Sets Prints	2 Sets Prints	2 Sets Prints
Prime Contractor	3 Sets Prints + 1 Set Calcs	3 Sets Prints + 1 Set Calcs	3 Sets Prints + 1 Set Calcs
M/E Section State Structures Design Office	N/A	N/A	Mechanical/Electrical - 1 Set Prints + 1 Set Calcs

When precast/prestressed concrete components are involved, the Department's District Prestress Engineer is furnished two (2) sets and the State Materials Office (Gainesville) is furnished one (1) set of prints. When structural steel components are involved, the Department's Assigned Commercial Inspection Agency (ACIA) is furnished two (2) sets. When mechanical/electrical components of movable bridges are involved, the Mechanical/Electrical Section of the State Structures Design Office (SSDO) is furnished one (1) set of prints and one (1) set of calculations.

The Contractor shall be responsible for transmitting a copy of the returned submittal to the appropriate subcontractor or fabricator.

When approval of a submittal is denied ("RESUBMIT" or "NOT APPROVED"), distribution of the submittal shall be made to the FDOT Review Office's File, when the Department is reviewing shop drawings, and the Prime Contractor only, with a copy of the transmittal letter to the Department's Resident Engineer.

28.10 Review of Prequalified Joint Welding Procedures

In accordance with **Section 11.2** of the **Materials Manual**, the approval of all joint welding procedures specification (WPS) will be the responsibility of the Department's Verification Inspection Consultant, which is the Department's Assigned Commercial Inspection Agency (ACIA). The State Materials Office maintains the list of the approved WPS which may be used on all future projects by the fabricator who developed them, until their expiration. A list of the welding procedures to be used on any individual project will be forwarded to the Engineer of Record (EOR) prior to the start of fabrication. The EOR may elect to review these documents, but it is the responsibility of the Verification Inspection Consultant to assure the proper welding procedure is used at the correct location. Shop drawings depicting plate sizes, types of welds, weld designations, weld sizes, grades of materials, etc. will continue to be reviewed by the EOR.

The fabricators of the following products are only required to include their approved Welding Procedure Specification as part of their quality control plan:

1. Overhead cantilevered sign supports with cantilevered arms less than or equal to 41 feet,
2. Overhead span sign supports,
3. Aluminum light poles,
4. High mast light poles,
5. Expansion joints,
6. Roadway decking,
7. Bearings,
8. Monotube Assemblies,
9. Mast arm assemblies,
10. Drainage items,
11. Stay-in-place forms,
12. Casing pipes,
13. Steel strain poles,
14. Pedestrian/Bicycle Railings
15. Any other items that are not designated as items requiring commercial inspections.

28.11 Submittal Activity Record (Logbook)

The Final Review Office is responsible for maintaining a Submittal Activity Record (Logbook) on each project reviewed by the office. The logbook shall be updated each day that any Shop Drawing submittal activity occurs.

The following minimum data shall be entered in the logbook for each submittal:

1. Financial Project ID and State Project Number (if assigned).
2. Submittal Number.
3. Description of Submittal.
4. Number of Sheets in the Submittal.
5. Number of Pages of Calculations, in Reports, in Manuals, etc.
6. Date Transmitted by Contractor to the Engineer of Record.
7. Date Transmitted by Engineer of Record (when EOR is not the final reviewer) to the Final Review Office.
8. Date Distributed by the Final Review Office to the Contractor.
9. Disposition as either "A" (Approved), "AN" (Approved as Noted), "R" (Resubmit) or "NA" (Not Approved).

The Logbook is an historical record of the activity devoted to an individual submittal as well as that for the project as a whole. It can serve as a verification of review time, to respond to inquiries of a particular submittal's status and as a record of manpower effort to aid in estimating and allocating future workload.

28.12 Archiving Record Shop Drawings

Upon completion and acceptance of a construction project by the Department (usually by receipt of a written Notice of Acceptance), the Final Review Office, within thirty (30) days, shall transmit the Record Shop Drawings to the appropriate offices, as dictated by district practice in the District in which the project is located. The Record Shop Drawings may include some or all of the following documents:

1. Shop Drawings
2. Erection Drawings
3. Calculations
4. Manuals
5. Project Files of Shop Drawing transmittal letters, etc.
6. Submittal Activity Record (Logbook printout)

The Final Review Office shall complete the Record Shop Drawing Transmittal (see **Exhibit 28-D**), in triplicate, retaining one (1) copy and transmitting two (2) copies, along with the Record Shop Drawings described above, to the appropriate office. The Record Shop Drawing Transmittal describes all the Record Shop Drawing documents being transmitted.

The Submittal Activity Record (logbook) is intended to serve as the listing of all Shop and Erection Drawings transmitted. Other transmitted material such as project files, samples, etc. should be listed individually on the Transmittal shown in **Exhibit 28-D**.

Upon receipt of the Record Shop Drawings, the offices receiving the transmittal shall verify the documents, material, etc. transmitted, sign and date both copies of the Record Shop Drawing Transmittal, retain one (1) copy for his files and return the second signed copy to the Final Review Office.

The Final Review Office shall maintain a file of Record Shop Drawing Transmittals (**Exhibit 28-D**) for future reference and use. Once the signed copy of the Record Shop Drawing Transmittal is received, the Final Review Office's initially retained Record Shop Drawing Transmittal may be discarded.

It should be noted that for Shop Drawing submittals requiring a Specialty Engineer, the Record Shop Drawing submittal normally will consist sealed prints.

Exhibit 28-A Shop Drawing Flow Diagram for Review by Consultant EOR Only (Structural and Movable Bridge Items)

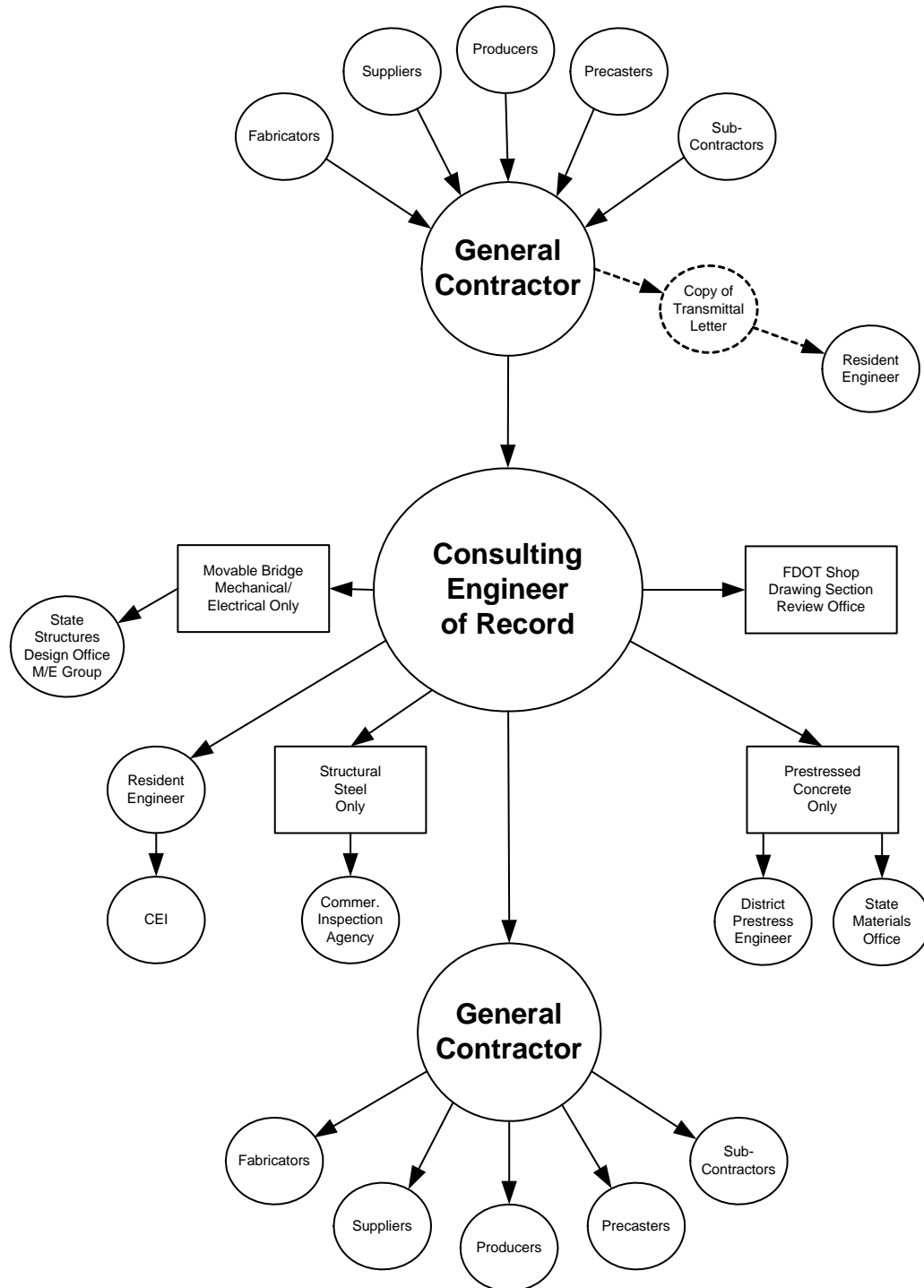


Exhibit 28-B Shop Drawing Flow Diagram for EOR & DOT Review (Structural and Movable Bridge Items)

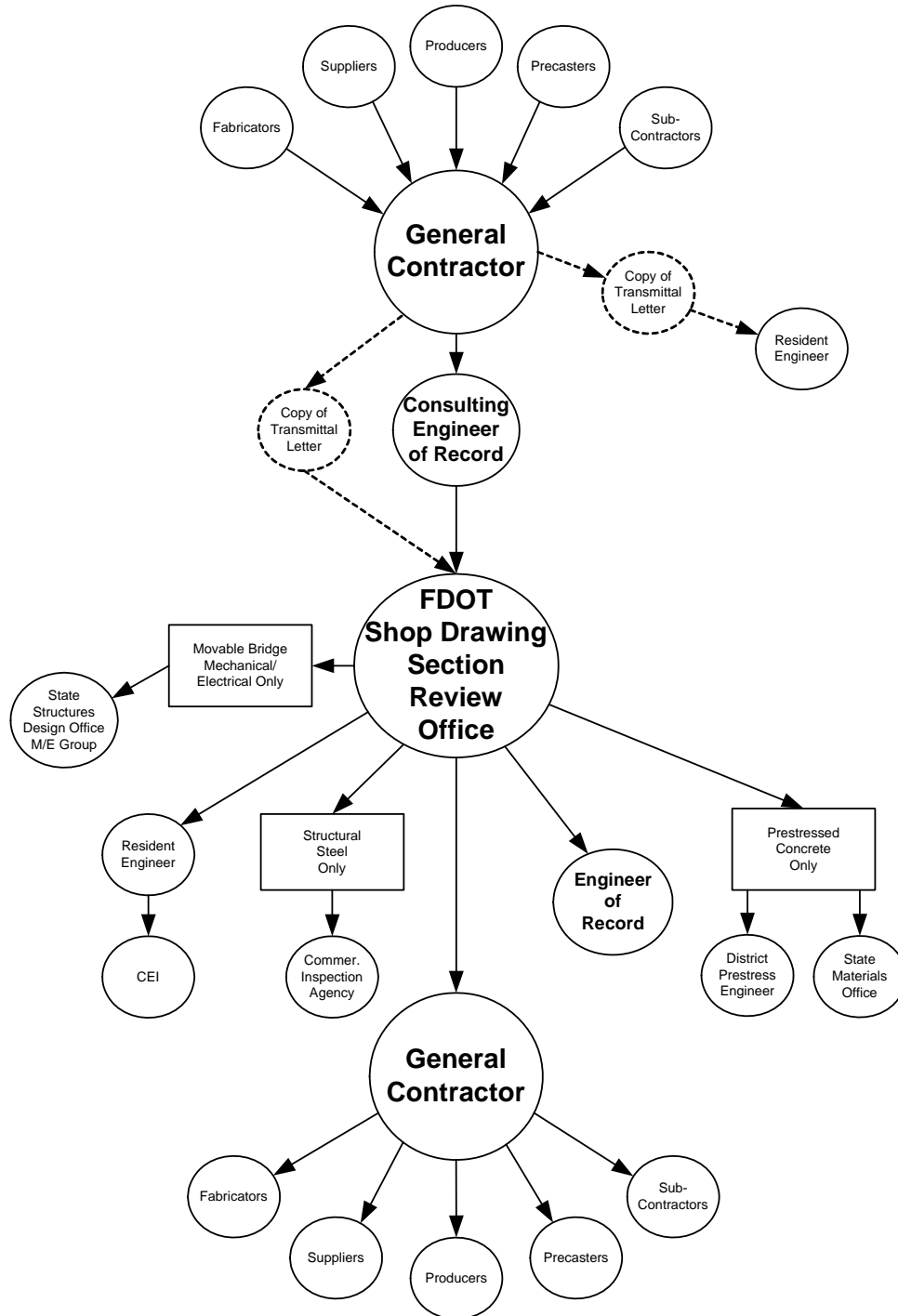
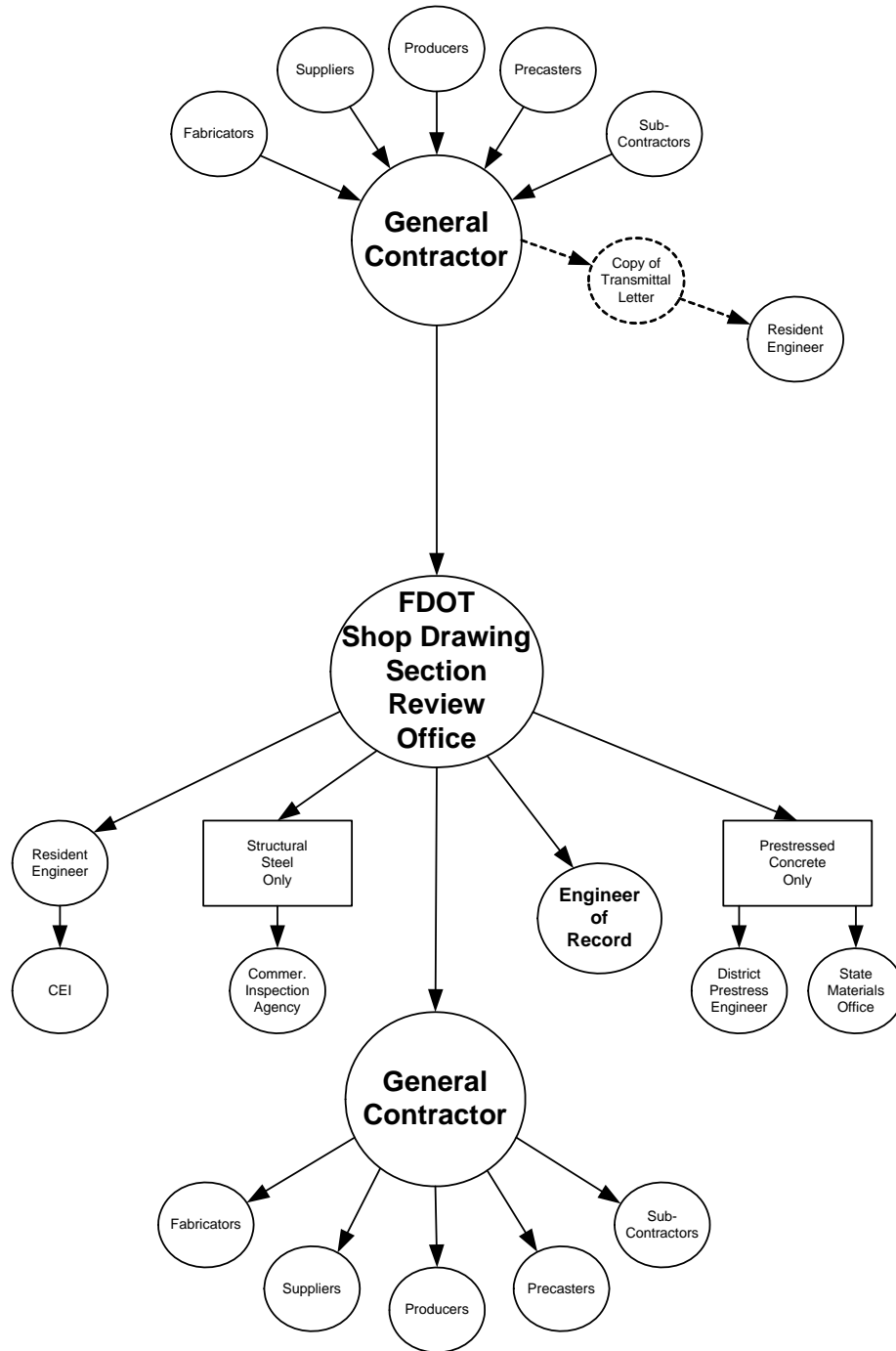


Exhibit 28-C Shop Drawing Flow Diagram for Review by DOT Only (Structural Items)



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Exhibit 28-D Record Shop Drawing Transmittal

(Letterhead of Final Review Office)

RECORD SHOP DRAWING TRANSMITTAL

Date _____

TO: (Destination Office)

FROM: _____

(Final Review Office)

PROJECT NAME _____

FINANCIAL PROJECT ID _____

FEDERAL AID PROJECT NO. _____

CONTRACT ID NUMBER _____

COUNTY (SECTION) _____

STATE ROAD NUMBER _____

BRIDGE NUMBER _____

CONTRACTOR _____

ENGINEER OF RECORD _____

We are transmitting herewith the following Record Shop Drawings for archiving:

1. Shop and Erection Drawing Submittals per attached Logbook.
2. Submittal Activities Record (Logbook)
3. _____
4. _____
5. _____
6. _____

For the Final Review Office: _____
(Signature) (Date)

For the Receiving Office: _____
(Signature) (Date)

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