



- 4-01.1 PURPOSE.** Detail plans are prepared to provide the information and details necessary to construct highway improvements to standards and criteria required by the functional classification and anticipated traffic. The plans show all existing topographic features and the disposition of existing improvements affected by the proposed construction. The plans also show the right of way necessary to allow room for the construction and maintenance of the improvement, and in sufficient detail to write deeds and acquire the right of way to the dimensions shown on the plans. The quantities for the work required to construct the improvement in accordance with the plan details are included in the plans. The plans convey to prospective bidders a conception of the amount of work required to construct the improvement. All of this information is shown graphically in detail on the plans and on tabulations that supplement the detail plans. The plans are a permanent record of conditions prior to the construction work. Reproductions of the plans serve as a basis for preparing final plans upon completion of the work, which are a permanent record of work performed.
- 4-01.2 DISTRICT/GENERAL HEADQUARTERS RESPONSIBILITY.** All detail plans, except bridge plans, are prepared and completed in the district and submitted to the GHQ Design for processing and letting contracts. General Headquarters Design acts in a consulting capacity during the preparation of the plans. General Headquarters Design personnel are available to consult with the district any time problems arise. Conferences may be arranged either in the GHQ Design office or in the district. Requests for advice and assistance are encouraged so that controversial items can be decided upon as the work is progressing, rather than after completion. The district is fully responsible for the accuracy, neatness, and completeness of detail plans.
- 4-01.3 PLAN PREPARATION.** Upon receiving final location and design approval based on the preliminary plan and public hearing, as appropriate, the district is to proceed with completing detail plans. Methods and practices for preparing sheets for plans and items incidental to plan preparation are given in [Section 4-03](#).
- 4-01.3 (1) DESIGN CRITERIA.** Plans are developed on the basis of design criteria, policies and procedures as given in this manual. Design controls set out in this manual are generally minimums and are exceeded whenever practical. Other publications such as AASHTO's *A Policy on the Geometric Design of Highways and Streets* ("Green Book"), FHWA's *Manual on Uniform Traffic Control Devices* ("MUTCD"), and AASHTO's *Roadside Design Guide* may be referred to as needed. Where special conditions require the use of criteria or procedures not covered in the standards or this manual, GHQ Design may be consulted to establish criteria and procedures for the special conditions.
- 4-01.3 (2) STANDARDIZATION.** Plans, and procedures for their preparation, are standardized to the greatest possible extent to promote design efficiency and to promote ease in reading and interpreting the plans. Standardization includes the use of standard legends, abbreviations, and methods of noting repetitious plan details. Full utilization is made of all current standard plans. References on the plans to standard plans and standard specifications are usually not necessary or desirable.
- 4-01.3 (3) COORDINATION OF DESIGN FEATURES.** The designer has a large responsibility in coordinating the various design features to provide highway improvements that are safe, serviceable and require a minimum amount of maintenance. Design variables are chosen with safety as the primary objective. Economy is also a prime consideration, particularly for improvements with a low design traffic such as many improvements for the supplementary system, but appearance and service should not be overlooked. The various design features, such as horizontal and vertical alignment, drainage facilities, intersections, and paralleling roadways are viewed as a whole in three dimensions.
- 4-01.3 (4) WORKMANSHIP AND NEATNESS.** CADD generated plans are developed when feasible and shall be prepared in accordance with [Specifications of Computer Deliverable Contract Plans](#). Detail plans shall be complete, concise, and always reflect good workmanship. The neatness and legibility of all drawings and notes are important. Detail plans are normally reproduced by a process that reduces their dimension by approximately one half and, in turn, their area by approximately one fourth. For legibility and clearness, this

requires large, open, bold style lettering. When manual drafting methods are used, freehand lettering is preferred over machine lettering. The use of fancy lettering or symbols is discouraged. Standard abbreviations are used with discretion. Words and terms used in notes on the plans are in accordance with those used in the standard specifications and the definitions as defined in [Section 1-01](#). Tracings are handled carefully to avoid soiling, tearing, and rolling or damaging of edges. The workmanship and neatness of all drawings are to be checked by the district prior to submission.

4-01.3 (5) ACCURACY. Plans, plan quantities, and plan dimensions are developed on the basis of accuracy and to significant figures consistent with the basic data on which they are developed and consistent with the unit of measurement and basis of payment for the items being considered. It is useless to compute angles, curve lengths, etc. for interchange geometrics to 0.001 foot and 0 degrees 00 minutes 01 seconds accuracy when the survey data, on which the calculations are based, are measured to the nearest 0.01 foot and 0 degrees 00 minutes 6 seconds. Another example is that detail drafting and calculations for a precise length of box culvert are not necessary because the end lengths of box culverts are measured, and quantities are computed, on the basis of a length to the nearest foot. Accuracy for dimensions used in the preparation of plans is shown in [Figure 4-01.1](#). The accuracy for other items is consistent with the figures given. Where computed items are rounded to the specified accuracy or quantity, half increments, or more, are rounded to the next higher unit. Less than half increments are rounded to the next lower unit.

4-01.4 PROCEDURE. The preparation of detail plans resolves itself into five basic steps, which are (1) preliminary preparation, (2) design field check, (3) completing design and plan details, (4) final field check, and (5) completing detail plans, specifications, and estimates.

4-01.4 (1) PRELIMINARY PREPARATION. As soon as the plan-profile sheets and culvert section sheets are plotted, a set of prints is made for use on the design field check. The names of all property owners and their property lines are included on the tracings prior to making the prints. The preliminary plan grade, with adjustments resulting from the preliminary calculations of grading quantities and bridge layouts, is drawn on the prints. The grade line placed on the prints represents an approximately balanced grade. The grading quantities, including approximate borrow and waste quantities, are indicated on the prints. The need for state furnished borrow area is established in accordance with the policies in [Section 4-08](#). If borrow areas are to be provided, the location is decided during the design field check. General Headquarters Design is advised of the proposed borrow area to arrange for cultural resource surveys. Two copies of a written Request for Environmental Services should be submitted to the GHQ Design to initiate cultural resources work on proposed borrow areas to be acquired by the Commission. A form for this use (see [Figure 2-02.2](#)) can be found in the Environmental/Cultural Resources category of the Design forms on the computer system.

Culvert section locations are shown on the prints by a line on the plan sheet. The drainage area for each culvert section is indicated. Selecting the location and size for drainage structures requires consideration of various factors and the exercise of good engineering judgment. Culverts are located generally along natural stream channels if practical. If this is not practical, the culvert is located so that the inlet end is approximately in the natural stream channel. If neither of these is practical, consideration is given to constructing ditches or channel changes, and locating the culvert accordingly. The shape of the natural stream influences the shape of the drainage structure. Culverts are located, if practical, in such manner that the direction of natural drainage is not changed. The culvert size is checked, particularly culverts for branching drainage areas. The slope line for the grade indicated on the plan-profile sheets is indicated on the culvert section prints, along with tentative flow line elevation for the culvert.

The survey field notes are reviewed to the extent required for the designer to become familiar with the contents of field books and the data in the books. All available topographic maps, photographs, and any other maps or material that may be useful for reference on the design field check are assembled for use on the field check. Shortly before the design field check, the locations of all culverts are staked by the survey party. The staking consists of a stake at the survey centerline and a stake near each end of the proposed culvert. The end stakes are marked to indicate the distances from the survey centerline to the stake, measured along the culvert section, and the difference in elevation between the natural ground at the stake and the tentative culvert flow line. All of these data are necessary to properly perform the design field check. The field check is not made until these data have been completed.

4-01.4 (2) DESIGN FIELD CHECK. When all of the required data have been assembled, the rough balancing of the earthwork has been accomplished, preliminary culvert layouts completed, basic drainage plan developed, and intersection layouts developed, the design field check is made. The prints, survey field books, maps, photographs, and the cross section tracings are taken on the design field check. The designer and one or more assistants, accompanied by the project manager perform the field check. The district right of way agent also participates in this field check to assist in the determination of design details relative to right of way features. The field check is performed by walking the location and checking and deciding on all design details, including the following:

- The location and size of all drainage structures
- The location of all entrances, approaches, outer roadways, and the size and location of drainage structures required for these features
- The selection of tentative locations for borrow areas
- The quantities for clearing and grubbing
- The methods for handling traffic, including the location of bypasses and the size and location of drainage structures required for them

- The location of areas which may require erosion control, such as special ditches, berms, interception levees and ditches, etc.
- The location of special ditches, berms, channel changes, and any other drainage controls that will be required to properly handle the drainage

The survey information is checked for accuracy and completeness. If survey errors are detected or if the survey data is incomplete, appropriate notes are made to instruct the survey personnel of the data that is to be checked or supplementary data that is to be obtained. Additionally, all structures affected by the project are reviewed and photographed as necessary for use by Cultural Resource staff.

The designer makes notes on the prints of all decisions reached and data collected during the design field check. A memo to the file compiling this information is suggested for providing a record for easy reference and review. The notes on the prints serve as a basis and guide for completing detail plans. Upon completing the design field check, any incomplete or inaccurate survey data are completed or corrected in the field. The designer then has the information and data necessary to complete right of way plans.

As the design proceeds, situations may arise where additional design field checking is required. It may be necessary to consult with other district personnel in GHQ Construction, Maintenance, Traffic, Materials and/or Right of Way. A good procedure is for the designer to maintain a list of items that need further checking in the field and to return to the field only when the list is of sufficient length to warrant a return or when such information is required to complete detail plans.

4-01.4 (3) COMPLETING DESIGN AND PLAN DETAILS. The procedure for completing the design and plan details is subject to wide variation because each improvement may require a different procedure, and because it is generally necessary to do some skipping around in order to keep the design coordinated and the design squad productive. The best procedure is to select a convenient point to begin completing design details and complete all details as they are encountered. In all cases the grading is approximately balanced prior to completing design details. The designer studies the grades and makes changes to finally balance the earthwork with the least effect on design features. A good procedure is to defer, as far as practical, the detailing of culverts and other design features in areas where grades are to be adjusted until final grade adjustments are made. Special ditch designs are coordinated with culvert designs. The tabulation of quantities is deferred until after all design details and the final field check are completed. This stage of plan preparation includes completing the design of all features and plan details including right of way, provisions for handling traffic, culverts, approaches and access control, and culvert section sheets.

As soon as design details are completed to the extent necessary to permit the completion and approval of right of way plans, the district can proceed with acquiring the right of way and completing any railroad and utility adjustment negotiations as outlined in Chapter 7. The 2B sheets, other tabulations, special provisions, etc., are not started until after the final field check has been performed. Shortly before performing the final field check,

all culvert locations are staked by a survey party. The culvert locations are staked similar to the staking required prior to the design field check, except that the stakes are set at the ends of culverts as finally designed.

- 4-01.4 (4) FINAL FIELD CHECK.** The final field check is made to provide a final review of the decisions reached on the design field check and a final check of the detail design. The final field check is not normally made until after the preliminary right of way negotiations have been completed and all features of the proposed detail design determined. The final field check is performed by at least the following: project manager, district operations engineer, and the designer. On some projects, it may be desirable to include district right of way personnel. The field check is performed by walking the location. Prints of the completed plans, survey field books, photographs, maps, draft special provisions, and any other necessary supplemental data is assembled by the designer prior to the final field check and are taken on the final field check. During the final field check the designer notes on the prints all decisions reached for reference in completing plans and making any necessary changes. Immediately following the final field check a memo to the file covering the decisions made at the time of the final field check, and which involve a significant change in the plans, is prepared by the designer, and furnished to the project manager, with a copy to the district operations engineer and other district personnel who were involved in the field check. If proper procedures are followed during the design field check and the detail design of the plans, the necessity for making plan revisions after a final field check should be minimized.
- 4-01.4 (5) COMPLETING PLANS.** After the final field check, the designer is in a position to complete the detail plans. Any corrections or revisions in plans that are required as a result of the final field check are made and the 2B sheet, other tabulations, estimate of cost, special provisions, and all other items necessary to complete the plans are completed. Items such as special provisions and unusual design features are reviewed and coordinated with other functional units within the district. The district is responsible for all checking of plans. A complete check of the detail plans must be made before they are submitted to General Headquarters. It is also essential that checks be made at various stages of plan design. To simplify the final completion and assembly of the plans, the designer maintains, during the design, a list of required special provisions, standard plans, unusual design items, and other information which will be useful for reference to write special provisions, to complete the plans, and to write the letter of transmittal.
- 4-01.5 COORDINATION WITH FEDERAL HIGHWAY ADMINISTRATION.** Cooperation between MoDOT and FHWA is essential to provide for efficient and orderly interaction of the two agencies. Full consideration is given to the recommendations and suggestions made by FHWA personnel. In order to facilitate coordination with FHWA and provide for a team approach to design reviews, FHWA should be requested to participate as a member of the MoDOT review team for all design field checks and final field reviews for full oversight projects, as defined in [Subsection 1-04.2](#). FHWA reviews should be made at the same time they are performed by MoDOT personnel.
- 4-01.6 POST DESIGN MEETINGS.** Following the completion of the design phase of a project and submittal of the PS&E, there are still opportunities for the core team to meet and discuss the project. At a minimum, the core team should re-convene to conduct a post-design and post-construction meeting. Additional core team meetings may be advisable as construction progresses if there are questions about the design or unforeseen conditions arise.

The intention of these meetings is to discuss the successes and lessons learned from the project and look for suggestions on how to improve the scoping and design of future projects. The minutes from any post-design or post-construction meeting should be forwarded to GHQ Design for implementation of best practices statewide.

The following benefits can be realized from the post-design and post-construction meetings:

- Best and worst practices will be identified for use in future projects.
- Allow a method for core team members to provide feedback on how well the project satisfied the identified need.
- Allow for incorporation of previously approved VE proposals or similar projects.