



## CHAPTER II PRELIMINARY DESIGN

### SECTION 2-01

### CONCEPTUAL STUDY

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**2-01.1 PURPOSE.** A conceptual study is used to coordinate department thinking on the improvements to be included in a project and to obtain approval as required. The approved study is then used as the basis for further design. A conceptual study is prepared for each project in the program. The format of the study is dependent on the proposed improvements.

A conceptual study consists of a written report as a 3R conceptual study report or a 4R pavement rehabilitation analysis and conceptual study report or a location study/environmental report. Location study/environmental reports are discussed in [Section 2-02](#).

**2-01.2 CONCEPTUAL STUDY REPORT.** A conceptual study report, using the format given in [Figure 2-01.1](#), is prepared by the district for projects of the following nature:

- Relatively small projects providing specific improvements such as signalization, lighting, signing, or minor geometric revisions.
- Projects such as bridge replacements on rural low volume roads where it is obvious that the only practical corridor location is the existing or adjacent to the existing corridor.
- Projects environmentally classified as categorical exclusions (CE).
- Projects pending classification as a categorical exclusion (CE2) must have the justification approved by FHWA, which results in a CE determination, prior to preparation of the conceptual study report. The CE2 form is available on the LAN. (If the CE2 is determined by FHWA to be an EA, a location study/environmental report is required. See [Section 2-02](#).)

For projects such as signalization projects, the conceptual study and preliminary signal layout may be combined in one submittal. Projects that primarily consist of improvements to the driving surface and shoulders, with limited geometric improvements, require the preparation of a specialized conceptual study in the form of a 3R or 4R report.

There may be some CE or CE2 projects for which it is advisable to prepare a location study report rather than a conceptual study report. This should be considered in the case of a highly controversial project, or one in which two or more alternatives is being considered that would have different impacts on the community, such as locating an interchange. This process is detailed in [Subsection 2-02.3 \(1\)](#). In this case, for a CE2 project, the location study report is prepared concurrently with the CE2 form to aid in FHWA determination for a CE or an EA classification.

Approximately 2 months prior to preparing a conceptual study report, the district sends two copies of a written request for environmental services to GHQ Design requesting project scoping, screening, and early constraint identification. 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. Preliminary scoping may have been completed in order to obtain a CE classification from a CE2, however, it is necessary to request more detailed scoping to complete the conceptual study report.

The conceptual study report describes the project purpose and need, location and proposed improvements, explains any variations from the approved program, and identifies existing and proposed features of simple bridge replacements or other minor road construction projects. In a few instances, a project that uses a conceptual study report format will have alternates being considered. In this case, all alternates considered should be documented in the conceptual study report in a manner similar to a location study report.

Accident data, safety enhancements, and access management should be discussed in the report. The accident data is obtained from the Transportation Management System (TMS). The calculation for the project accident rate is shown in [Subsection 2-01.5](#). The accident data is carefully analyzed by the designer. Any unusual circumstances are noted and recommendations for correction are proposed. Safety enhancements such as guardrail or bridge modification, access management, and the need for bicycle/pedestrian facilities are also discussed.

The conceptual study report should also discuss the disposition of the existing route. This discussion should document the anticipated disposition of all sections of the existing route in a manner similar to a location study report. A description of the available options for disposition is listed in [Subsection 2-02.4 \(6\) \(c\)](#).

If the current estimated cost is different than the programmed cost, the difference is explained in the remarks section of the report.

All environmental work completed prior to the conceptual study report is summarized and included in the conceptual study report. The conceptual study report then discusses any unusual features or anticipated difficulties to be encountered with the project, such as known archaeological sites, historic bridges, wetlands, Section 4(f) or Section 6(f) lands, hazardous waste sites, or other environmental issues as provided by GHQ Design. Current cost estimates, borrow information when required, and any other pertinent information to the project that is not covered elsewhere are also provided under the remarks section of the report.

A location sketch, existing and proposed typical sections and other documents as necessary, are attached to show the proposed improvement.

Following the signature of the preparer, a section is included for the recommendations or comments of the District Engineer. If necessary to add more detail, the District Engineer's comments may be submitted with a separate letter. Following that, signature and date lines are included to indicate the District Engineer's approval of the study.

Minimum design standards are given in [Figures 4-04.1](#) and [4-07.1](#). Justification for varying from these standards must be submitted on a Design Exception Information form, as discussed in [Subsection 2-01.8](#), to GHQ Design for approval.

Approval and submittal of the conceptual study report is detailed in [Subsection 2-01.9](#)

**2-01.3 PAVEMENT REHABILITATION PROJECTS – NON-FREEWAY ROADWAYS.** A 3R conceptual study report form, as shown in [Figure 2-01.2](#), is prepared by the district for all Resurfacing, Restoration and Rehabilitation (3R) on non-freeway roadways. All 3R projects are designed to meet or exceed minimum design standards as given in [Figures 2-01.3](#) and [2-01.4](#) for rural highways and [Figure 2-01.5](#) for urban highways. The values shown in [Figure 2-01.5](#) apply to any portion of a 3R project located within the limits of a city or town. Justification for varying from these standards must be submitted on a Design Exception Information form, as discussed in [Subsection 2-01.8](#), to GHQ Design for approval.

Approval and submittal of the 3R conceptual study report are detailed in [Subsection 2-01.9](#).

**2-01.3 (1) PROJECT INFORMATION.** Any difference in the project information from that programmed is explained in the letter of transmittal.

**2-01.3 (2) TRAFFIC DATA.** The designer requests traffic data from GHQ Transportation Planning or the TMS database. The data needed is shown on [Figure 2-01.2](#).

**2-01.3 (3) PAVEMENT DATA.** The district recommends the rehabilitation method. Any difference in the proposed pavement or shoulder structure from that shown in [Section 604](#) and [Section 605](#) is explained in the letter of transmittal.

The Strategic Highway Research Program manual titled "Distress Identifications Manual for the Long-Term Pavement Performance Project" is used to describe the pavement distress. The cause of the distress, such as inadequate pavement structure or moisture related damage, is noted if known. An estimated amount of pavement repair is given (see [Subsection 6-05.4](#)). It should be noted that all pavement repairs must be doweled or tied into adjoining pavement to be eligible for federal funds. Badly deteriorated concrete pavement may need to be replaced in its entirety.

If the distresses are such that the district is unsure what the rehabilitation strategy should be for a given project, a

written request should be submitted to GHQ Project Operations to conduct a pavement evaluation. Accompanying the written request should be, at minimum, the information required in Part I of a 4R Pavement Rehabilitation Analysis Data and Conceptual Study Report, with the exception a straight-line profile of the existing pavement for each direction of roadway is not required. The designer should allot 4 to 6 weeks for the evaluation to be completed and recommendations to be returned to the district.

- 2-01.3 (4) GEOMETRIC DATA.** The horizontal alignment, vertical alignment, and other features of the highway section are compared to adjoining sections. Any items within the clear zone are listed. The design exceptions reflect the minimum distance to objects in the clear zone.
- 2-01.3 (5) ACCIDENT DATA, SAFETY ENHANCEMENTS, AND ACCESS MANAGEMENT.** The accident data is obtained from the TMS database. The calculation for the project accident rate is shown in [Subsection 2-01.5](#). The accident data is carefully analyzed by the designer. Any unusual circumstances are noted and recommendations for correction are proposed. Safety enhancements such as guardrail or bridge modification, management of access, and the need for bicycle/pedestrian facilities are also discussed.
- 2-01.3 (6) PROJECT COST DATA.** If the current estimated cost is different than the programmed cost, the difference is explained in the letter of transmittal.
- 2-01.4 PAVEMENT REHABILITATION PROJECTS FOR FREEWAYS.** A 4R pavement rehabilitation analysis and conceptual study report form, as shown in [Figure 2-01.6](#), is prepared by the district for all Resurfacing, Restoration, Rehabilitation and Reconstruction 4R projects on interstates and freeways. For these roadways the additional option of reconstructing the pavement must be evaluated. Part I of the form is filled out and submitted to GHQ Project Operations, with a copy to GHQ Design, in order to initiate the pavement rehabilitation analysis. If only one pavement rehabilitation method seems appropriate or a method is preferred by the district, supporting information should be provided with Part I of the 4R report. The rehabilitation analysis by GHQ Project Operations will not be conducted until the project is in the third year of the program, and is preferred to be conducted when the project is in the second year of the program.

Once the rehabilitation analysis has been conducted and returned to the district, Part II of the form is completed and non-paving costs are prepared for each alternate provided in the rehabilitation analysis. Part II and the non-paving costs are submitted to GHQ Project Operations, with a copy to GHQ Design. All 4R projects are designed to meet or exceed minimum design standards as given in [Figure 4-04.1](#). Justification for varying from these standards must be submitted on a Design Exception Information form, as discussed in [Subsection 2-01.8](#), to GHQ Design for approval.

After review of the information and approval of the requested design exceptions, GHQ Project Operations will submit Parts I and II of the 4R report, the rehabilitation analysis, and all costs (paving and non-paving) to FHWA for approval. GHQ Design will submit the approved Design Exception Information form to FHWA for approval. Upon approval by FHWA, copies of the approval letter will be sent to the district by GHQ Project Operations, and GHQ Design in the case of a design exception, with copies of the approved documents.

- 2-01.4 (1) PROJECT INFORMATION.** Any difference in the project information from that programmed is explained in the letter of transmittal.
- 2-01.4 (2) TRAFFIC DATA.** The designer requests traffic data from the Office of Transportation Management Systems. The data needed is shown on [Figure 2-01.6](#).
- 2-01.4 (3) EXISTING PAVEMENT DATA.** The Strategic Highway Research Program manual titled "Distress Identifications Manual for the Long-Term Pavement Performance Project" is used to describe the pavement distress. The cause of the distress, such as inadequate pavement structure or moisture related damage, is noted if known. An estimated amount of pavement repair is given (see [Subsection 6-05.4](#)). It should be noted that all pavement repairs must be doweled or tied into adjoining pavement to be eligible for federal funds. Badly deteriorated concrete pavement may need to be replaced in its entirety.

Any items that might restrict the addition of pavement thickness to the existing traveled way are noted. These

might include drainage structures, curbing, median barriers, right of way restrictions, or other special conditions.

The straight line profile identifies the location of all bridges, including overpasses, by log mile and station, and indicates at each location the field measured vertical clearances. It also states if the bridge is to be used in place, rehabilitated or reconstructed. [Figure 2-01.7](#) gives an example of a straight line profile.

An example of a sketch showing existing lanes, additional lanes proposed under the project, and additional lanes programmed in the future is shown in [Figure 2-01.8](#). The width of the median and location of existing bridges, including overpasses, is also shown on this sketch. The location of each item is identified by log mile.

**2-01.4 (4) PROPOSED PAVEMENT DATA.** The proposed pavement data is submitted by the district after the rehabilitation method has been determined by GHQ Project Operations. If the proposed pavement rehabilitation method is different than the one recommended by GHQ Project Operations, justification must be provided.

**2-01.4 (5) GEOMETRIC DATA.** The horizontal alignment, vertical alignment, and other features of the highway section are compared to adjoining sections. Any items within the clear zone are listed. The design exceptions reflect the minimum distance to objects in the clear zone.

**2-01.4 (6) ACCIDENT DATA AND SAFETY ENHANCEMENTS.** The accident data is obtained from the TMS database. The calculation for the project accident rate is shown in [Subsection 201.5](#). The accident data included in Part II is used to determine whether a special surface needs to be applied to reduce the accident rate. The accident data is carefully analyzed by the designer. Any unusual circumstances are noted and recommendations for correction made. Safety enhancements such as guardrail or bridge modification, and the need for bicycle/pedestrian facilities are also discussed.

**2-01.4 (7) PROJECT COST DATA.** If the current estimated cost is different than the programmed cost, the difference is explained in the letter of transmittal.

**2-01.5 ACCIDENT RATE CALCULATION.** An accident rate is calculated for each project and included in the conceptual study.

The formula for the accident rate is as follows:

- accident rate =  $\frac{\text{no. of accidents} \times 100,000,000}{\text{no. of yrs.} \times 365 \times \text{weighted ave. ADT} \times \text{length in miles}}$
- accident rate =  $\frac{5 \text{ yr. total accidents} \times 54,794.52}{(5 \text{ year}) \times \text{weighted ave. ADT} \times \text{length in miles}}$

The accident rate yields a result in accidents per hundred million vehicle miles traveled (HMVMT). The number of accidents is the total number of accidents in the study period. For conceptual reports a five year study period is used, utilizing the last five full years of traffic accidents. The ADT and accident data is obtained from the TMS database maintained by GHQ Transportation Planning. The calculated accident rate is compared to the five year average statewide rate for a similar class of highway as obtained from GHQ Transportation Planning or found in the Traffic Accident Statistics Manual from GHQ Transportation Planning.

**2-01.6 BASIC LIGHTING.** Basic lighting is provided along the major road at any interchange within the limits of a 3R or 4R project that meets the warrants given in [Section 8-01](#). If warranted, basic lighting is shown as part of the scope of the project and included on the Project Initialization / Estimate Form.

**2-01.7 GUARDRAIL.** Criteria for upgrading guardrail are given in [Subsection 4-09.7 \(2\)](#).

**2-01.8 LOGICAL TERMINI.** All 3R and 4R projects must have logical termini.

**2-01.9 DOCUMENTATION OF DESIGN EXCEPTIONS.** Documentation of design exceptions is necessary for the department to be able to defend itself from litigation. Litigation may take place many years after the actual

construction and permanent documentation is necessary to determine the justification for design exceptions.

Design exceptions consist of items that vary from the "Project Development Manual". In most cases the need for design exceptions are the result of the inability to reasonably meet the minimum design standards or criteria specified in this document. However, there are occasions where the improvements will greatly exceed the normal standards recommended for that type of improvement. These variations must also be documented through the design exception process. When there is doubt if a design exception is required, the Project Development Liaison Engineer should be consulted.

The request for traveled way design exceptions must be initiated and signed by the project manager in charge of the project. If the project is being designed by a consultant, the consultant's project manager should initiate the request and sign the design exceptions form first. All consultant design exceptions are reviewed by the district and signed by the district's project manager prior to submittal to GHQ Design. Design exceptions for bridge items initiated by GHQ Bridge should adhere to the following process:

1. GHQ Bridge prepares the design exception information form (see [Figure 2-01.9](#)). NOTE: GHQ Bridge project managers do not sign this form.
2. GHQ Bridge project managers should transmit, electronically if possible, the design exception information form to the district project managers for review and signature.
3. District project managers will submit the design exception information form to GHQ Design for final processing.
4. GHQ Design will be responsible for obtaining approval signatures as necessary and furnish the district and GHQ Bridge with copies of the final approved document.

Requests for design exceptions are made when the need first arises; specifically at submittal of the conceptual study, preliminary plan, right of way certification, or plans, specifications, and estimate (PS&E).

The Design Exception Information form shown in [Figure 2-01.9](#) is used to request design exceptions. Additional supplemental sheets may be attached as needed. Whenever minimum design standards cannot be met, data for only those substandard items is listed. This data includes the existing feature (if applicable), the minimum design standard for that feature, the proposed feature, and the location of that feature. The column shown for existing features is not applicable to new construction. The appropriate values for minimum design standards are shown in the second column. The design standards for new construction on rural highways and 4R projects are given in General Design Data Notes ([Figure 4-04.1](#)). Design standards for construction of new urban highways are given in [Figure 4-07.1](#). The minimum rural design standards for 3R projects are given in [Figures 2-01.3](#) and [2-01.4](#), and the minimum urban design standards for 3R projects are given in [Figure 201.5](#). The criteria for proper access management can be found in MoDOT's [Access Management Guidelines](#). On urban projects, turning lane width and whether the pavement is curbed or uncurbed are noted on this form. A Design Exception Information form is not required if all minimum design criteria are followed.

All requests must contain reasons to justify the exceptions. It is imperative that the justification be sufficiently complete to clearly reflect that reasonable care was exercised by the designer in the selection of a particular highway design. It should be kept in mind when writing the justification that design exceptions arise because it is impractical or impossible to reasonably meet a specific design standard. If the standard can be reasonably met, then the item in question should be built to standard. The justification may include appropriate economic analysis, discussion of applicable accident location and type or discussion of avoidance of Section 4(f) or Section 6(f) lands. The justification should support the concept that maximum service and safety benefits were realized for the cost invested. Engineering judgment should be used when balancing the economic and engineering reasons for the justification. A design exception is based on sound engineering judgment rather than an attempt to save cost.

All requests are submitted to GHQ Design, where the Project Development Liaison Engineer reviews and forwards them to the State Design Engineer. After approval by the State Design Engineer (or the State Bridge Engineer for bridge items only), the Project Development Liaison Engineer notifies the District and/or GHQ Bridge. Design exceptions on "non exempt" projects (interstate, major bridge and other special projects) are also required to be approved by FHWA. The Project Development Liaison Engineer will submit the approved design exceptions to FHWA when required.

Changes in project scope, design criteria, standards, or general design policy could result in changes to design exceptions previously submitted. In this case, an amended Design Exception Information form must be submitted to GHQ Design for approval. The amended form should include all exceptions previously approved. The letter of transmittal indicates if prior design exception approval was given.

GHQ Design maintains the design exceptions in a permanent project file. A copy of the form is also kept in the district file.

**2-01.10 CONCEPTUAL STUDY REPORT APPROVAL AND SUBMITTAL.** The District Engineer has the authority to approve all project specific details as contained in the right of way and construction program for projects that meet the requirements to use a conceptual study report, 3R conceptual study report or 4R conceptual study report. For projects requiring a location study/environmental report, the approval and submittal requirements are described in [Section 2-02](#). This approval by the District Engineer is contingent upon the approval of any design exceptions by the State Design Engineer or approval by the FHWA as described below.

All "non-exempt" projects (interstate, major bridge or certain special projects) require federal oversight and require the additional approval of the conceptual study report by the FHWA. For these projects, the conceptual study report, 3R conceptual study report, or 4R conceptual study report and any requested design exceptions are submitted to GHQ Design. GHQ Design, upon approval of the design exceptions, will send a transmittal letter and necessary information to FHWA for review and approval. Upon receipt of FHWA approval, GHQ Design will inform the district to proceed with the design of the project and forward with a copy of the approval action.

"Exempt" projects (all other projects) do not require direct federal oversight and will therefore not be submitted to FHWA for approval. The District Engineer may approve the conceptual study report, 3R conceptual study report, or 4R conceptual study report for these projects as long as MoDOT design criteria established in this document are followed. A copy of these reports should be forwarded to GHQ Design. For those projects where a design exception is required the District Engineer's approval of the report is contingent upon approval of the requested design exceptions. The district should submit the request for design exceptions to GHQ Design with a copy of the report. Upon approval of the design exception, the district shall have authority to proceed with the design of the project.

In both of these situations, the district will provide GHQ Design and Project Operations a copy of the approved conceptual study report.

**2-01.11 AIRPORTS.** If a highway improvement is located within 2 miles [3 km] of an existing airport, a letter should be submitted to GHQ Design as directed in [Subsection 2-06.8](#).

**2-01.12 SEMA FLOOD BUYOUT PROGRAM.** The State Emergency Management Agency (SEMA) has the ability to place permanent deed restrictions on lands located in floodplains. These restrictions require open space land usage only, no structures, roadways or fills are allowed. [Figure 2-01.10](#) contains a list of cities and counties which have SEMA buyout properties. If a project encroaches on any of these jurisdictions, an official with the city or county must be contacted to identify the exact location of the deed restricted properties.

**2-01.13 DRAFT PROJECT SCOPING MEMORANDUM FOR SYSTEM EXPANSION PROJECTS.** Following approval of the conceptual plan for Major Projects, the Draft Project Scoping Memorandum should be completed by the project manager and submitted to the Design Technical Support Engineer for review and comment. The details of the Draft Project Scoping Memorandum can be found in [Subsection 1-02.7\(1\)](#).