KYTC Highway Design	***Chapter*** GENERAL INFORMATION
	Subject Design of This Guidance Manual

ORGANIZATION & NUMBERING:

Chapter Title—The subject matter in the manual is divided into chapters. The chapter title appears in the upper right-hand corner of the first page of a subject and in the upper left-hand corner of any subsequent page.

Subject Title—The title of a subject appears in the upper right-hand corner of the first page of a subject and in the upper left-hand corner of any subsequent page.

"HD" Prefix—Preceding each subject number, this prefix stands for the manual title *Highway Design.*

Date—The latest issuance date of a subject appears at the bottom of each page of the subject. This date agrees with the latest issuance date shown for the subject in the Table of Contents **(HD-01).**

Page Numbering—Each subject has its own page numbering, which appears at the bottom of each page.

LOCATING INFORMATION:

Two indexes appear at the front of the manual, and one index appears at the back:

- **Table of Contents (HD-01)**—This index at the front lists the titles of the manual's chapters and their subjects, as well as other information, in numerical order. It includes the latest issuance dates of all the subjects. As the manual matures, these dates change.
- **Alphabetical Index (HD-02)**—This index at the front alphabetically lists key information in the manual. Generally, it directs the user to subject titles and to margin, paragraph, and subparagraph headings within subjects.
- **Table of Exhibits (HD-9900)**—This index at the back lists the manual's exhibits, including forms, worksheets, diagrams, etc., by number and title.

CONT.

CROSS-REFERENCES IN MANUAL:

Subject Numbers within Narrative—A subject number within the narrative on a page directs the user to more information about the subject.

QUESTIONS:

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KYTC Highway Design

Chapter

GENERAL INFORMATION

Subject

Purpose of This Guidance Manual

PURPOSE:

The purpose of the *Highway Design Manual* is to present detailed or descriptive design information for Kentucky road projects. This manual has been prepared to provide guidance to personnel of the Transportation Cabinet and primarily to the road designer. The guidance supplied in this manual is based upon Kentucky common practice and relies on guidance from other resources when practical.

This *Highway Design Manual* places an emphasis on flexibility. The goal is to be permissive by default and explicit where needed. Sufficient flexibility should encourage independent designs tailored to particular situations. New guidance and detail are added to this *Highway Design Manual* to cover some areas that have been historically lacking or vague. This manual should not supersede the application of sound engineering principles by experienced design professionals.

KYTC Highway Design	***Chapter*** GENERAL INFORMATION
	Subject Highway Design Philosophy

PHILOSOPHY: The design philosophy presented in this manual is in harmony with the Federal Highway Administration's (FHWA) goal stated in its "Flexibility in Highway Design" publication "to design highways that incorporate community values and are safe, efficient, effective mechanisms for the movement of people and goods." The designers' challenge is to balance their commitment to preserving and protecting the environmental and cultural values in communities while also providing a highway facility that is safe and that provides the necessary mobility to ensure economic opportunities and an improved quality of life.

Design is a key ingredient in the project delivery process, and it is important to realize that the different functional components must work together to deliver projects. Environmental analysis, right-of-way acquisition, utility relocation, etc., are also key components of project delivery, and each component must be considered in the project decision. The National Environmental Policy Act of 1969 (NEPA) is the backdrop for the Cabinet's transportation decision-making process. The NEPA process requires decision-makers to use a systematic and interdisciplinary approach. They should consider the environment, along with economic and technical considerations. In short, they should consider the three E's—Engineering, Environment, and Economics—in all decisions. Highway designers should work with the different functional units to determine the best transportation decision.

There is much discussion throughout this manual about the roles of project development teams (PDTs), project managers (PMs), and the Central Office role. The Division of Highway Design is in place to participate and provide support for the PDTs in the transportation decision-making process. The division will ensure that processes and design decisions are followed appropriately. They will also provide special expertise to the teams.

As expectations for better, safer roads have increased, a growing awareness of community needs has also emerged. This has contributed to development of the concept of Context Sensitive Design (CSD), which is a key principle utilized by the Cabinet. CSD is a way of thinking about projects and not just a process that utilizes different standards or merely makes aesthetic enhancements.

CONT.

PHILOSOPHY (cont.):

As stated in the U.S. Code Title 23, "Highways"; Chapter 1, "Federal-Aid Highways"; Subchapter I, "General Provisions"; Section 109, "Standards"; in subsection (a), "In General":

> "The Secretary shall ensure that the plans and specifications for each proposed highway project under this chapter provide for a facility that will—
>
> (1) adequately serve the existing and planned future traffic of the highway in a manner that is conducive to safety, durability, and economy of maintenance; and
>
> (2) be designed and constructed in accordance with criteria best suited to accomplish the objectives described in paragraph (1) and to conform to the particular needs of each locality."

Title 23, Section 109, also provides: "A design for new construction, reconstruction, resurfacing (except for maintenance resurfacing), restoration, or rehabilitation of a highway on the National Highway System (other than a highway also on the Interstate System) may take into account, in addition to the criteria described in subsection (a)—

> (A) the constructed and natural environment of the area;
>
> (B) the environmental, scenic, aesthetic, historic, community, and preservation impacts of the activity; and
>
> (C) access for other modes of transportation."

Taking into account the Title 23 provisions, designers realize that the decision-making process is integral to the successful implementation of CSD. Designers must place the following project-related qualities in the forefront of the decision-making process:

- The project satisfies the purpose and need as agreed to by a full range of stakeholders. This agreement is forged in the earliest phase of the project and amended as warranted as the project develops.
- The project is a safe facility for both the user and the community.
- The project is in harmony with the community, and it preserves environmental, scenic, aesthetic, historic, and natural resource values of the area.
- The project exceeds the expectations of both designers and stakeholders.

CONT.

PHILOSOPHY (cont.):

- The project involves efficient and effective use of the resources (time, budget, community values) of all involved parties.
- The project is designed and built with minimal disruption to the community.
- The project is seen as having added lasting value to the community.
- Communication with all stakeholders is open, honest, early, and continuous.
- A multidisciplinary team is established early, with disciplines based on the needs of the specific project and with the inclusion of the public.
- A full range of stakeholders is involved with transportation officials. The purposes of the project are clearly defined, and consensus on the scope is forged before proceeding.
- The project development process is tailored to meet the circumstances. This process should examine multiple alternatives that will result in a consensus.
- The public involvement process, which includes informal meetings, is tailored to the project.
- The landscape, the community, and valued resources are understood before engineering design is started.
- A full range of tools for communication about project alternatives is used (for example, visualization).

As a result of CSD principles, designers should be flexible in decision-making concerning the design decisions made about each project. The PDT has the responsibility of weighing all the particulars of a given project and making design decisions accordingly. Design decisions should consider equally safety, mobility, and preserving scenic, aesthetic, historic, environmental, and community values. Design criteria shown in AASHTO's "A Policy on Geometric Design of Highways and Streets" are intended as a guide allowing flexibility to encourage independent designs. Ranges of values are key in Green Book criteria, with the utilization of higher values in the ranges where social, economic, and environmental impacts are not deemed critical. Sound engineering judgment is to be used in situations where these impacts are more pronounced.

CONT.

PHILOSOPHY (cont.):

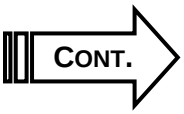
During the early project development or conceptual design process, there are key decision points where the PDT must come together and make decisions that will help determine the outcome of a project. These key decision points are in line with the NEPA decision-making process. The PDT must realize that the product of the conceptual phase is a transportation decision with an approved environmental document based on an alternate and not just the preliminary line and grade plans. There is only one product: the transportation decision documented in the environmental document and reflected in the engineering plans.

KEY DECISION POINTS:

There are key points during the development of a project when the PDT must come together and make decisions. To better accommodate this process, the PDT should follow the steps below in the shared transportation decision-making process:

- **Purpose and Need:** Purpose and need of a project are a key decision point of the shared decision-making process. Purpose and need provide the foundation for successful decision-making and the basis for the evaluation and comparison of reasonable alternatives. For each project, the PDT will agree to a purpose and need that will be utilized to establish the scope of the required work. The scope describes the boundaries of the project and defines the expected project deliverables. The project team will also use this purpose and need to develop alternatives and to guide their decisions. For projects where the Division of Planning has completed studies, the project team should review, revise, and adopt the purpose and need presented in the planning report, with consensus reached on any necessary modifications.

- **Range of Alternatives:** The next key decision in the shared transportation decision-making process is to determine an area of study within which a range of alternatives that meet the purpose and need can be developed. At this point in the process, the design team (consultant or in-house) presents a range of alternatives that meet the purpose and need of the project. Alternatives/corridors previously evaluated during the development studies conducted by the Division of Planning should be the beginning point. Alternatives/corridors that were eliminated during the development studies should not require further investigation and should not be reconsidered unless new data or conditions warrant such study. Key environmental features within the corridor should be identified and mapped before alignment studies commence. The project team may eliminate alternatives from further consideration with adequate supporting documentation. While a preferred alternative may stand out, the project team should resist making a recommendation until they understand all relevant impacts and issues.



KEY DECISION POINTS (cont.):

Following the review of the alternatives, the subject-matter experts (SMEs) would then proceed with an evaluation of those alternatives left for consideration. SMEs are those professionals who have specific expertise available to the project team within the Cabinet's various divisions and through consultant contracts. For example, the environmental SMEs are the functional professionals responsible for completing the environmental baseline work. They are the biologists, archaeologists, noise and air experts, and other professionals who evaluate the existing conditions and determine the possible environmental impacts. Project teams also receive subject-matter expertise from the Divisions of Highway Design, Structural Design, Right of Way and Utilities, Traffic Operations, Maintenance, and Construction. While some of these SMEs may be core members of the project team, each division is responsible for responding with the necessary level of timely support and guidance when this expertise is not available at the district level. It is the responsibility of the project team and project manager to identify and request these services.

The SMEs will need to consider a corridor approach as opposed to a given alignment so that adjustments can be made to avoid or minimize impacts. They also need to remain involved in the decision-making process to ensure impacts are considered, and offer suggestions on how to minimize or mitigate when necessary. Evaluation of the range of alternatives should also include preliminary information about the total project costs. The project team consists of members from the various functional areas of the Department of Highways. The input of these members should be solicited throughout the project development process.

The output from the range of alternatives phase should consist of the list of possible, practical, and feasible alternatives that fulfill the purpose and need. The study area for each alternative should also be available.

- **Scope of Impacts:** This is the next key decision point in the progression of alternative analysis and shared transportation decision-making. The SMEs should present to the project team the results of their investigations, including the baseline studies and the corresponding impacts of each of the alternatives on the study area. They would also offer suggestions on the risk associated with moving forward with each alternative and the time frame involved in resolving identified impact issues—i.e., 4(f) involvement that could take an additional 12 months to resolve, stream mitigation that would cost $450,000, or a 10-inch gas main that will require relocation. Right-of-way professionals and utility agents would also present their findings during this meeting so that the project team can fully consider the possible impacts that property acquisition and utility location (both public and private) might have on the transportation decision.

CONT.

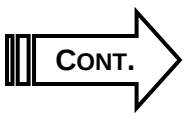
KEY DECISION POINTS (cont.):

When the SME has uncovered information that could have a significant impact to the budget and schedule of the project, the SME and project manager will need to inform the project team so that other members can consider the impact that information may have on their decisions.

When determining the impacts, the project team must work through the decision-making process, which includes avoidance, minimization, mitigation, and possibly even enhancement efforts necessary to address the impact. The project team may brainstorm potential opportunities to avoid, minimize, or mitigate these impacts considering environment, economics, and engineering. The project team could also make decisions or determine that additional information is required to further investigate the alternatives. Then after that investigation, the investigators would present their evaluation to the project team detailing the impacts/issues involved with each alternative. The project team would discuss and possibly determine a recommended alternative.

All decisions will be documented and included in the draft environmental document, which would subsequently be finalized, reviewed, and approved by FHWA. The output from the scope-of-impacts phase could include the draft environmental assessment or categorical exclusion, preliminary alternative plans, right-of-way and utility impacts with associated costs, possible mitigation measures, and the corresponding project costs and schedule impacts. If public and resource agency involvement is determined to have been sufficient, the project team may identify a preferred alternate in the environmental document prior to conducting the public hearing.

- **Selected Alternative:** Following the approval of the draft environmental document and the public hearing, the project team will select a preferred alternative based on environmental, economic, and engineering issues and public input. This is the final key decision point of shared transportation decision-making in the conceptual stage of the project. The final environmental document would then be prepared, reviewed, and approved by FHWA. The output would be the final approved environmental document and the selected alternate to proceed into Phase II Design.



KEY DECISION POINTS (cont.):

The purpose of these key decision points is to ensure that the environmental and design processes are integrated. Historically, the design process has been "out in front" waiting on the environmental process. This created a seemingly endless reiterative loop of obtaining environmental information, modifying the design, conducting further environmental investigations, and modifying the design again. The key decision points procedures ensure that the different entities are providing the necessary input to the project team at the appropriate time to make the best possible transportation decisions. These new procedures weave the roles and responsibilities together on each project team to create a truly shared transportation decision-making process.

The project team has the flexibility to combine these key decision points on a project-by-project basis. Smaller projects may offer the opportunity to combine the range of alternatives and scope of impacts. However, some projects may require further discussion of avoidance, minimization, and mitigation and require opportunities for the project team to convene and discuss. Each of these decision points should be discussed and considered before a final decision is made. It is also important that all project team members are aware of the intent to combine the decision points and that SMEs be prepared to concurrently address the issues associated with each decision point.

These key decision points must be a model for all projects and therefore should be included in the consultant contracts as scheduled milestones. The project team with the appropriate input from SMEs must determine the time required for completing their respective responsibilities and set the schedule appropriately.

As stated before, the transportation decision-making process requires the different functional divisions within the Cabinet to work together. The Division of Highway Design is an integral part of this process and must work with other divisions to ensure projects are delivered.

KYTC Highway Design

Chapter

GENERAL INFORMATION

Subject

Organization

ORGANIZATIONAL CHARTS:

The Division of Highway Design is one of four divisions under the responsibility of the Deputy State Highway Engineer (DSHE) for the Office of Project Development. Under the direction of the State Highway Engineer and his or her assistants, the Project Development DSHE:

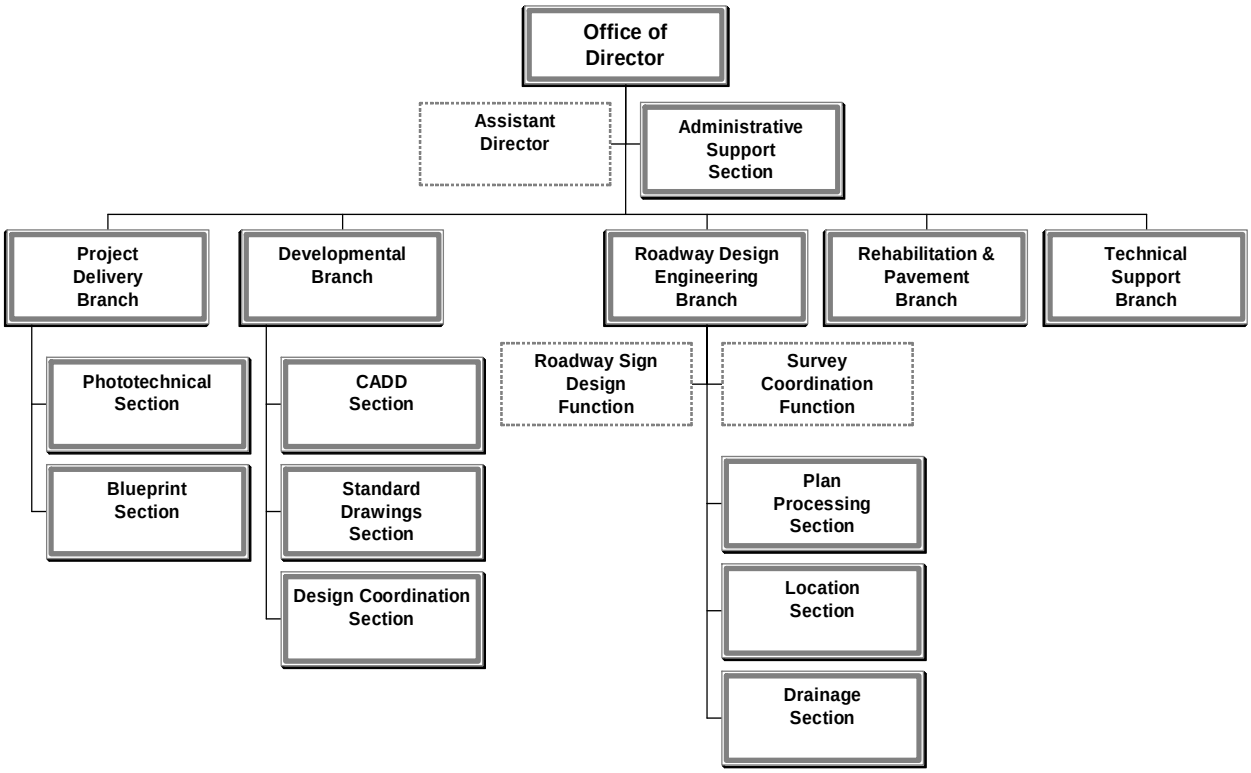
- Supervises the engineering functions of the Department of Highways
- Plans and develops highway-engineering programs
- Recommends new and revised policies and procedures to the State Highway Engineer
- Provides executive leadership and guidance to their functional areas

The Division of Highway Design, in conjunction with the district design offices, is responsible for the required design activities for the Cabinet's Six-Year Highway Plan projects. This responsibility includes conducting the studies, computations, and analyses necessary to support the preparation, assembly, and reproduction of the construction plans for a project's award.

CONT.

ORGANIZATIONAL CHARTS (cont.):

Division of Highway Design
Central Office



CENTRAL OFFICE: The primary responsibilities of the Division of Highway Design in the Central Office are to:

- Develop criteria, procedures, and policies for highway/roadway design
- Ensure consistency of projects
- Offer technical expertise and assistance to project managers, project teams, designers, and others associated with development and delivery of highway projects
- Provide or facilitate opportunities for training as it relates to highway design criteria, procedures, and policies
- Deliver the final project to the letting process

CONT.

CENTRAL OFFICE (cont.):

The Central Office Division of Highway Design comprises five branches:

- Project Delivery Branch
- Developmental Branch
- Roadway Design Engineering Branch
- Rehabilitation and Pavement Branch
- Technical Support Branch

The director's office includes the director and an assistant director, well as the Administrative Support Section, which provides administrative support to the whole division.

- The **Project Delivery Branch,** which supports the plan development process, comprises two sections:

  - The **Phototechnical Section** produces or reproduces aerial photographs for documentation, research, displays, and other related preconstruction engineering studies and activities. Photogrammetric mapping and aerial photographs are integral aspects of any project development and are used to support alternate location studies as well as for development of displays and related materials that are used for Cabinet presentations and public meetings.

  - The **Blueprint (Reprographics) Section** reproduces full-size and half-size plan sets for each construction letting. The number of projects varies from year to year and is dependent upon the size of the highway construction program. The size of each plan set varies, depending upon the length and complexity of each project. With multiple copies of each plan set, the total number of plan sheets reproduced will number several thousands each year. In addition to reproductions for highway plan projects, the Blueprint (Reprographics) Section reproduces large-size plan sets for other divisions within Transportation and other state agencies.

- The **Developmental Branch** comprises three sections:

  - The **CADD (Computer-Aided Drafting and Design) Section**

    - Provides displays, studies, and reports as requested for the Secretary, State Highway Engineer, and others, including highway studies for the Economic Development Cabinet

    - Serves as a technical resource for the director's office and the Location Section by preparing studies and preliminary estimates

CONT.

CENTRAL OFFICE (cont.):

- Develops construction plans for unique or particularly challenging projects that may be assigned to the section

- Works closely with the Technical Support Branch, using Six-Year Highway Plan production projects and state-of-the-art technology

  Note: The Technical Support Branch refines, develops, and supports the Department of Highways' CADD implementation efforts by offering services on CADD equipment and applied operations training for users of highway design software and hardware.

♦ The **Standard Drawings Section** provides special detailed standard drawings and regularly updates the standard drawings utilized in construction plans. These standard drawings are made available to designers and project managers in the plan development phases and to construction engineers and contractors once a project is awarded. In addition, the section:

  - Maintains a complete current file and index of roadway and traffic Standard Drawings converted to full-size reproducible plan sheets and distributes them for use on special projects

  - Maintains a history file on specific drawings and microfilms outdated drawings

  - Conducts research and investigation on new products, ideas, processes, and innovations and prepares notes and specifications when needed

  - Performs follow-up inspections on projects using newly developed design standards to determine any needed modifications or improvements

  - Checks shop drawings after projects are under construction

  - Prepares detail drawings on an as-needed basis for other sections

♦ The **Design Coordination Section:**

  - Processes intergovernmental reviews through the State Clearinghouse

CONT.

CENTRAL OFFICE (cont.):

- Works with project managers to provide technical assistance relative to the requirements for holding and documenting public hearings and meetings

- Annually processes through the Statewide Clearinghouse between 2,000 and 2,500 review/coordination documents, which include:

  ✓ Intergovernmental reviews
  ✓ Environmental reviews
  ✓ Public notices
  ✓ Notices for non-Six-Year Highway Plan projects

  The number of public hearing/public meeting documents processed annually ranges between 80 and 100.

➢ The **Roadway Design Engineering Branch** comprises three sections and houses two additional function groups:

♦ The Roadway Sign Design function provides for the design of signing plans for interstates, parkways, and other high-volume roads where panel signs are needed. The design process is completed either in-house or through a design consultant, with an in-house review of consultant-designed plans prior to inclusion in the final project plans. A primary objective is to assure that all sign plans comply with the *Manual on Uniform Traffic Control Devices*, the *Roadside Design Guide,* and the Transportation Cabinet's *Traffic Operations Manual.* When requested by the project manager, Roadway Sign Design staff will make final inspections of completed projects. Roadway Sign Design staff also administers the Statewide Sign Maintenance Agreement to assure that all damaged panel signs and new or supplemental panel signs are promptly replaced or installed.

♦ The Survey Coordination function works with the district survey crews to ensure that field procedures and survey data adhere to the current CADD standards. This function of the Roadway Design Engineering Branch is also in charge of the statewide aerial photography contract and is responsible for ensuring that all mapping for Transportation Cabinet projects conforms with the CADD standards as well. All mapping requests come through this function of the division. In addition, Survey Coordination handles a statewide surveying contract. Survey Coordination works with National Geodetic Survey (NGS) to maintain statewide survey control networks such as the Kentucky Federal Base Network (FBN) and the National Geodetic Reference System (NGRS). The maintenance of these systems is an ongoing responsibility as well.

CONT.

CENTRAL OFFICE (cont.):

The Roadway Design Engineering Branch comprises three sections:

- The **Plan Processing Section** works with project teams for final assembly and review of all projects at the time of letting to ensure that plans are complete and suitable for letting and that all notes and standard drawings are current.

- The **Location Section** provides technical support, budget and scope oversight, and liaison (Central Office to/from districts) for project teams through all stages of design. These responsibilities extend to projects designed by the Department of Highways or by a consultant. Location engineers are primary resources for providing technical expertise and support for the project teams during all phases of design and plan development. The Location Section works on behalf of project managers and project teams to coordinate with outside agencies such as FHWA, other state agencies, and other divisions within the department to facilitate design activities. Location engineers participate in project team meetings from the preliminary engineering phases through the final plan development phases.

- The **Drainage Section** reviews drainage design engineering details and calculations on most projects. The section also reviews drainage permits, recommends corrections for drainage problems during construction and maintenance, and prepares the design for special drainage situations. Much of the review and technical assistance by the Drainage Section manifests itself in the findings of a “drainage folder” for each project. A project drainage folder summarizes the engineering and related drainage decisions that contribute to the design of each project.

➢ The **Rehabilitation and Pavement Branch:**

- Prepares, oversees, or reviews the preparation of pavement designs on all highway projects

- Develops criteria and procedures used for design of pavements, including structural design, life-cycle cost analyses, analyses for pavement type selection, etc.

- Provides technical assistance with pavement design issues in other areas such as construction, maintenance, and planning

- Manages and coordinates the department’s programs for structural rehabilitation of pavements, including management of a statewide contract for design of pavement rehabilitation projects

CONT.

CENTRAL OFFICE (cont.):

- Assumes direct design responsibility for many pavement rehabilitation projects on interstates, parkways, and other National Highway System routes

- Works with staff from the Federal Highway Administration (FHWA), the Transportation Research Board (TRB), the American Association of State Highway and Transportation Officials AASHTO), and the National Cooperative Highway Research Program (NCHRP) in the development and refinement of structural design criteria and procedures for pavement designs

➢ The **Technical Support Branch:**

- Supports the Department of Highways' statewide computerization effort in the project development area by offering services on CADD equipment and operations training for the Division of Highway Design and highway designers in the 12 district offices

- Works closely with the CADD Section to facilitate the implementation of highway design software and hardware into the project design and development process

KYTC Highway Design	***Chapter*** GENERAL INFORMATION
	Subject Design in District Office

DISTRICT DESIGN RESPONSIBILITIES: The Transportation Cabinet has 12 district offices spread throughout the state. The Chief District Engineer in each district is responsible for the project and all design functions performed by the district representatives, including preparation of plans and surveys, and the supervision of consultants. The Branch Manager for Preconstruction is responsible for managing the development of the projects and the preconstruction functional units in the district directly responsible for addressing the environmental, design, right-of-way, and utility issues associated with the project. Under the authority of the Chief District Engineer through the Preconstruction Branch Manager, the Project Manager has the responsibility of delivering the project to letting. As detailed previously in this chapter, the Division of Highway Design's primary function is to provide support for the highway design activities in the district offices. The Division of Highway Design is in place to participate in the transportation decision-making process and provide support for the project development team (PDT). The division will not only ensure that processes and design decisions are followed appropriately but also provide special expertise to the teams.

The Chief District Engineer is responsible for selecting the project manager and assembling the PDT. The PDT comprises cross-disciplinary functions from the district supplemented by Central Office subject-matter experts. The Chief District Engineer should encourage representatives from each functional area under his or her supervision to participate on the PDT. The transportation decision-making process requires the utilization of a cross-disciplinary team, and the PDT should include individuals from the different functional areas in the district and the Central Office.

The District Design Office should be familiar with the design criteria established by the Department of Highways as well as the requirements of the FHWA and the design guidelines contained in AASHTO's *A Policy on Geometric Design of Highways and Streets*, the *Roadside Design Guide*, and other technical documents contributing to the design process.