State of Georgia

Department of Transportation

Practical Design Guide

Practical Design Guide

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Version 1.0

Georgia Department of Transportation

GDOT

Georgia Department of Transportation

1. Introduction

The purpose of this document is to educate, inform and create a vision and foundation for how projects are planned, programmed and designed. Other Department guidance, policy, procedures and processes may be updated to build on this Practical Design Guide.

Our transportation industry faces challenges with establishing and maintaining efficient and effective processes and designs. While current plan development processes and designs often focus on maximizing benefit to the single **PROJECT** or aspect thereof. Practical Design should focus decision-making to maximize benefit to the statewide transportation **SYSTEM**. Changing the current culture to one of practical design will meet the goal to allow more system needs to be addressed by meeting individual project performance objectives for the least cost. Georgia DOT's Vision, Mission, Core Values and Goals are guiding principles in the Practical Design approach.

The users of this guide shall review the Preface and Chapter 1 of the 7th edition of the AASHTO Policy on Geometric Design of Highways and Streets (2018 Green Book).

In addition to the 2018 Green Book, to create this document, the Task Force also studied **NCHRP Synthesis 443**, *Practical Highway Design Solutions,* as well as the practical design guides and policies of the following states: Idaho, Kansas, Kentucky, Missouri, Oregon, Utah and Washington.

What the Task Force learned is that while each state has a different set of guidelines or policies, the main premise is the same: being flexible in design, and "designing up" allows each state to increase their overall number of projects and stretch their budgets. "Designing up" is defined as beginning with the existing condition and adding improvements until the needs and goals of the project are met. There are two key themes learned from this study:

1. **Approach the solution by "designing up" with flexibility in design.**
2. **Always ask "Why?" throughout design and plan development.**

2. What is Practical Design?

Practical Design can be defined many ways, but in its simplest form it is the design that satisfies the need and meets the performance expectations for each project by utilizing the most efficient and cost-effective solution(s) to solve or address the need(s) for the project. Designing in this manner will require a major cultural change for the transportation industry in Georgia. Instead of designing to the maximum design standards or to an ultimate broad ranging maximum solution, Practical Design is "designing up" from the existing condition, to meet the stated needs and goals.

This starts by establishing a clear and concise Project Justification Statement that outlines the NEEDS and GOALS of a project. Once this is established, it allows the design team to approach the problem from a performance-based perspective, "designing up" the solution to meet the projects needs and goals; not the owners' or teams' project wants or desires. This culture shift requires the project team to develop customized and innovative solutions specific to the project to satisfy needs, goals and budget.

Example:
Funding specifically programmed for replacement of structurally deficient bridges are intended to meet the NEED of replacing the bridge. Evaluating bridge hydraulic, geometric and safety deficiencies to document and record does not inherently require correcting unless funds are available and planned to address additional NEEDS and GOALS. Reference Case Study E.

The below bullet points outline a simple list of goals to be met by the project team to effectively practice Practical Design on a project.

How to approach solutions by "designing up" with flexibility in design

Reference the 2018 Green Book Sections 1.8 and 1.9

- Recognize the freedom to innovate
- Collaborate with full project team to ensure wide array of perspectives are received
- Optimize use of the PDP, Design Variances and Design Exceptions to best fit the project needs, goals, scope and funding.
- Approach challenges from performance-based perspective
- Develop customized, project specific solutions that may involve flexibility in design criteria
- Consider phased construction solutions that address more critical and current needs first and address lower priority needs in the future.
- Focus on scope conformance
- Balance scope, with project costs and maintenance costs without sacrificing future maintenance
- Maximize program results while providing the best value to the taxpayers
- Use engineering judgement with decisions by senior engineers and document why the solution is the best solution.

Always ask questions throughout plan development process

- Ask Why and What?
- Why is this project needed?
- What is the problem?
- What is the best solution?
- Why this design?
- Why do we need to adhere to this requirement?

In the current climate of our transportation industry, many of the team members involved on projects have become comfortable in designing to the maximums, with little regard to the budget, needs and/or goals of a project. It has become common practice to increase the projects' budget to design and build the "Cadillac" project.

In addition to retraining ourselves to a practical mindset by regularly reviewing what Practical Design is, it is also beneficial to remember what Practical Design is **NOT.**

Practical design is **NOT**:

- Designing to fit solutions to an unrealistic budget.
- Designing solutions that are unsustainable and create additional maintenance costs.
- Automatically designing to the maximum design standard.
- Designing solely to a checklist.
- Allowing scope creep.
- Adding stakeholder wants/desires to the detriment of the budget.

3. Goals and Objectives

Georgia DOT's Vision, Mission, Core Values and Goals are guiding principles in the creation of GDOT's Practical Design Approach. In 2019, the Department's vision and mission were revised to better reflect its focus on innovation as well as excellence in the delivery of all its products.

Georgia DOT's vision is to boost Georgia's competitiveness via leadership in transportation; the mission is to deliver a transportation system focused on innovation, safety, sustainability and mobility.

A focus on promoting the philosophies of Practical Design through all GDOT projects aligns with and helps meet the overall Vision, Mission, Core Values and Goals of the Department.

A. GDOT's Organizational Strategic Goals:
   i. Streamline processes and improve access to opportunities for small business.
   ii. Utilize Performance-based management, Innovation and Public-Private Partnerships (P3) to deliver GDOT's mission responsibly and more efficiently.
   iii. Provide multimodal transportation development and infrastructure throughout Georgia.
   iv. Put Georgians' safety first through innovation and technology.

B. GDOT's Statewide Strategic Transportation Plan (SSTP)Goals:
   i. Safety.
   ii. Maintain and Preserve the System.
   iii. Relieve Congestion and Improve Reliability.
   iv. Environmental Sustainability.
   v. Freight Movement and Economic Vitality.

C. GDOT's Practical Design Goals:
   i. Maximize the benefit to the entire transportation system, not to a single project.

ii. Meet the identified needs and goals established in the project justification statement of each project.
iii. Design the most cost-effective solutions without compromising safety.
iv. Deliver projects using the most efficient processes available.

D. GDOT's Practical Design Objectives:
   i. Recognize safety improvement is a priority.
   ii. Maintain scope of work.
   iii. Avoid project scope creep.
   iv. Utilize flexibility in design
   v. Reduce overall project costs.
   vi. Reduce project delivery time.

4. GDOT's Approach to Practical Design

A. Roles and Responsibilities

Numerous entities identify, plan and deliver projects on Georgia's transportation system that are funded by State and Federal dollars. A Project Team is defined as every agency, office, department and group that has a role in a project, i.e. owner, planner, stakeholder, operations, maintenance, design, review, delivery, construction and constructor. For the benefits of practical design to be realized, all agencies, offices, departments and groups must buy-in to the culture of practical design. A description follows for each entities duties and responsibilities for implementing practical design.

A project team consists of individuals with diverse experience and opinions representing individual project wants and desires. Project team members present data, analysis and options which identify solutions and recommendations. These solutions and recommendations may challenge design policy, design criteria, plan development process, etc. resulting in the need to make project specific decisions. The project owner ultimately decides which solutions to implement.

GDOT's role is significant in decision making process because it is the owner of the state system and it is responsible for oversight of state and federal funds. GDOT Divisions, Districts and Offices are designated project owners that have responsibility for their program, planning, budgets and projects. GDOT will make decisions on solutions ultimately at the Division level based on the data, analysis and options provided by the design and delivery team.

i. Georgia Department of Transportation
The roles and responsibilities of GDOT are described in the 2020 Strategic Plan Update. http://www.dot.ga.gov/AboutGDOT/TheNetwork/Publications
The Department's primary responsibility is to plan, construct, operate, and maintain Georgia's transportation network while focusing on innovation, safety, sustainability, and mobility.

ii. Metropolitan Planning Organization

The role and responsibilities of MPOs are integrated with the local, state and federal governments with primary responsibility to provide assistance in the planning, programming and funding of projects.

iii. Project Owner

For the purpose of this document, the project owner is GDOT because GDOT manages the State highway system and has oversight responsibility for Federal funds. A local government that identifies a project on their off-system roadway and secures Federal funds becomes a major stakeholder as GDOT serves as the owner during design and construction. A local government initially identifies/plans a project, funding and schedule through an MPO or GDOT.

Also, for the purpose of this document, GDOT's Divisions serve as owners as they are identifying/planning projects, funding and schedules for specific programs. When competing needs and desires increase project scope beyond the Project Justification Statement needs, GDOT's Chief Engineer provides resolution as The Owner.

iv. Design and Delivery Team

The Design and Delivery Team develops solutions and makes design decisions based on provided project information, project justification statement, needs, goals, budgets and schedules. This team is responsible for performing practical design, engineering and plan development through a specified plan development process that include:

- Evaluate the project justification statement, needs, goals, budgets and schedule
- Design solutions that meet the project justification statement. i.e. solve The Problem
- Avoid solutions and improvements that needlessly exceed the needs, goals, budgets and schedule
- Evaluate improvements in a corridor context and not just a project context
- Evaluate improvements from a long-term maintenance perspective and determine if they need to be implemented on the project level
- Consider solutions outside the project limits that will help meet the project or corridor needs and goals
- Design based on "designing up" from existing conditions to meet needs and goals and not by "stripping down" from an ultimate maximum broad ranging "Cadillac" solution
- Offer design solutions for other disciplines to meet needs and goals as a lower cost
- Coordinate practical design solutions with project stakeholders
- Perform cost analysis of design solutions, especially if not meeting design standards in order to understand and evaluate trade-offs.

Practical design requires each team member to perform the following tasks, but at a much higher level:

- **Collaborate** with team members and stakeholders to offer technical perspective.

- **Encourage** other team members to offer solutions.
- **Document ALL** decisions related to the project design and development.
- **Evaluate** projects for viability, given program parameters, funding, and schedule.
- **Look for changes** in assumptions, parameters, and design solutions and bring to the attention of the Project Manager and team.

Project managers are responsible for the following to help practical design benefit their project:

- **Determine** the point the design is good enough. i.e. meets the needs and goals.
- **Maintain** the right balance for the overall project and system when evaluating trade-offs.
- **Ensure** decisions are implemented appropriately and fulfill the project justification statement, needs and goals.
- **Ensure** the project team and all stakeholders continually review the scope to meet project needs and goals.

The design and delivery team are required to coordinate with operations for the following:

- **Evaluate** project and corridor maintenance concerns.
- **Address** project and corridor long term operations.

v. Operations

The Operations group(s) is responsible for the long-term operation and maintenance of the system. Coordination with the operations group(s) is necessary to develop or refine the project justification statements, needs and goals and to implement successful practical design.

The operations group(s) include maintenance, traffic operations, utilities and Districts and are responsible for the following to help the other groups implement practical design successfully:

- Identify and carefully explain/detail any current maintenance issues in the project limits
- Ensure that project is designed in a manner that can be effectively maintained from both performance and cost standpoints.
- Give clear understanding of maintenance costs and long-term operational needs.
- Assist in evaluating and developing practical design solutions that meet the objective statement.

vi. Subject Matter Experts

Subject matter experts (SMEs) provide various discipline expertise to project scope, process and design solutions. SMEs are an integral component of practical design and provide objective input and guidance throughout design development.

SMEs evaluate project process and solutions while considering the project justification statement, the problem, the need, the goals, budget and schedule in conjunction with AASHTO, design policy, maintenance and operations.

B. Components of Practical Design

i. Project Needs and Goals

Moving toward a more practical design-oriented culture, begins with development of the Project Justification Statement when the project **Needs**, and **Goals** are established. Clearly identifying the problem(s), clearly stating the needs and clearly outlining the goals will aid in establishing an accurate, realistic estimate of probable total project costs.

Establishing a budget based on an expected probable solution and most readily available information, will allow the project team to focus on the project needs and goals of all stakeholders and minimize the risk of scope creep throughout the life of project development. A realistic budget will support a realistic probable solution that addresses the need(s) of the project. If unable to establish realistic budget, a scoping phase is necessary to perform alternatives analysis and establish a preferred solution and scope of project.

Designing up from the current conditions with innovative solutions, allows for more projects to remain within or below the original budget.

ii. Plan Development Process (PDP)

Use of practical design in the PDP requires the experienced senior team members to use critical thinking in determining how best to meet the project's stated needs and goals. This begins in the planning process and early program delivery steps, where innovative plan development processes, probable design solutions and realistic budgeting based on the more expensive options are created.

During this process, consideration of facility type, scope of needs, goals, funding type and potential project risks should be evaluated to determine the preliminary engineering scope of work and the appropriate plan development process. Once the project scope is established, the project team can begin the appropriate engineering studies and evaluations that reduce project risks and add value to developing solutions that meet the overall needs and goals of the project.

iii. Design Criteria

It is a common misconception that the 2018 Green Book and the GDOT Design Policy Manual (DPM) are rigid and do not allow flexibility in their usage. Reference the PREFACE of the 2018 Green Book for guidance and intent, where it specifically notes that the manual does not supersede engineering judgement.

In addition, it specifically allows for flexibility for projects on existing roads. The GDOT Design Policy establishes guidance and standards, with flexibility for utilizing design variances and design exceptions. ***Reference the 2018 Green Book Section 1.7.***

Example:
As Construction limits of roadway improvement projects encroach on adjacent properties, a focused attention is needed to ensure complete understanding of these construction limits impacts. Often-times, these encroachments, can cause significant impacts to these properties. These impacts may include loss of parking, loss of maneuverability/circulation, loss or impact to septic system, etc. Therefore, the design engineer must evaluate design alternatives such as lane and/or sidewalk width reduction, front slope and back slope modification, retaining wall design, etc. to assist in mitigating these impacts. This analysis should include costs comparisons of both r/w and construction costs so that a practical and cost-effective solution is achieved.

iv. Flexibility
Context sensitive design and flexibility in design are necessary to develop solutions that meet the needs and goals. Using the flexibilities inherent in the 2018 Green Book and the GDOT Design Policy Manual are necessary. Incorporating flexibility in design criteria and standards and imposing engineering judgement is desired. ***Reference the GDOT DPM Sections 2.1.***

v. Value Engineering
Value engineering (VE), as practiced today, is a form of practical design, in that it requires members of the team to evaluate the design, ask Why and look at alternative solutions that meet both the project needs and goals, while reducing the overall project costs. Unlike today's "one and done" VE process, in the practical design process, is necessary from planning throughout construction.

The project team should be constantly asking "Why," and constantly evaluating whether the proposed solution is the most efficient and cost-effective method to meet the needs and goals of the project. By practicing VE throughout the life of the project, the engineer should deliver solutions that meet the needs and goals at the least cost considering total project costs.

C. Practical Design Phases

i. Planning Phase – Project Justification Statement

1. A main objective of the Planning Phase is to develop a justification statement that serves as the foundation for system improvements and project development. Every project will have a documented justification statement that specifies the deficiencies to be solved and the goals to be achieved by the proposed improvement project. Items that do not directly support the project

justification statement should be re-evaluated, redesigned or eliminated by the project team.

2. Part of the project justification that is critical to defining and developing the project is establishing the project design year/lifespan. Defining the lifespan provides the project team with a clear direction on how to design many features of the project from a "design up" perspective.

   While new location projects typically are designed to last a minimum of 20 years, there are many other projects - particularly maintenance and traffic projects - that may not be ideal for 20 or more years, as they are intended to be implemented quickly to correct a deficiency or safety concern. Without a clearly-defined design year for these types of projects, most project teams will default to 20-year design year, which could lead to unnecessary schedule delays and budget deficiencies for the project.

   For example, if a project objective states the desire for a 20-year pavement life, do not expect the design to exceed the designed 20-year life. It is critical to plan for maintenance and provide a design life to make sure the *system's* needs are met.

3. Practical design eliminates "over designing" improvements by aiming to achieve, but not exceed, the project justification statement. This allows our limited resources to be stretched throughout the system. These savings allow unfunded projects to be completed. By making each project "good enough," more of GDOT's system can be improved.

   Example:
   Not all projects require a "designed" profile for the vertical alignment. Many widening projects, intersection projects, and the like can easily be constructed by utilizing the "best fit" method of construction. In fact, Section 149 of the Standard Specifications requires the contractor to obtain three-point levels and "best fit" the existing profile. On projects where the existing pavement structure is retained, and no vertical alignment changes are warranted, this is a viable option saving money and time in many aspects. This approach to design may also be used on bridge replacement projects where the existing vertical alignment does not need to be changed. Graphic grade profiles can be used in many cases.

4. The project originator (i.e. Planning, Maintenance, Traffic Operations, Bridge, Local Sponsor) is responsible to define the initial project justification statement. The project justification statement should be analyzed as needed through the early life of the project (i.e. concept, EA/EIS, etc.) to ensure the objective(s) identified will adequately meet the system and corridor needs.

5. Another element of the practical design approach is to eliminate "wants" from the project. When creating the project justification statement, it is important to

be able to distinguish between what is needed for the project to be successful, and what is a betterment, or a want.

Determining a want can be difficult, especially on projects with many stakeholders. Each will typically have certain ideas that they feel are "needs" as it better suits them in the long run, while in reality their "need" is a "want" and does not meet the goal of the project justification statement. Typically, a "want" and a betterment adds cost to the project.

6. The project justification statement defines the goals of the project and not a specific solution. For example, the project justification statement should ***not*** say, "The objective of the project is to add a lane."

   The following is a list of some of the key elements of the project justification statement.
   - Define in terms that are easily understandable to the general public.
   - Present information in a manner that is comprehensive and specific.
   - Be factually and numerically based.
   - Evaluate all appropriate modes of transportation.
   - It is the what, not the how.
   - State the project justification in a concise manner.
   - State as an expected positive outcome.

   The goals established for each project shall be project specific, and as detailed as practical for meeting the needs of the project and project type. Each different project type should have specific goals.

   Some examples of project types and specific goals are as follows:
   - Safety Projects
     - Reduce crash frequency and severity.
   - Congestion Improvement/Capacity Projects
     - Improve Level of Service (LOS).
   - Traffic Improvements
     - Improve LOS.
     - Reduce crash frequency and severity.
   - Structural
     - Correct deficiency.
     - Improve lifespan of structure.
   - Enhancement
     - Pedestrian connectivity.
     - Beautification.

ii. Planning Phase – Budget

1. Once the project justification statement is created, a project planning phase budget should be established to allow for the outlined needs, goals and lifespan to be met by the project team. Often, this budget should end up being established for the most reasonable “worst case” solution to address the project justification statement based upon the most readily available information at the time.

   This will allow the project team to evaluate all potential concept solutions for the project and select the concept that not only meets the stated Goals, Needs, Lifespan and Objectives outlined, but is also the most cost-effective solution not exceeding the requirements of the project justification statement.

2. Establishing a realistic budget is critical for the proper planning and programming and delivery of not only the project, but the entire program. As discussed in Section 2.0, practical design is “designing up;” in other words - beginning with the existing condition and adding improvements until the needs and goals of the project are met. It is not “designing to budget” or cutting (or adding) features until the programmed cost is met.

   A project team following the practical design guidance of this document should evaluate the project by “designing up,” which should avoid including stakeholder wants, and eliminate scope creep to meet the project justification statement. By doing these things, often, the preferred solution should be either at budget or under budget. These cost savings in the long run will be returned and allow for additional projects to be constructed.

iii. Concept

Practicing practical design during concept development may in fact slow down the design process as compared to pre-practical design process.

Practical design requires a more intentional effort and focus to finalize and document all assumptions while establishing the project “boundaries” for critical design elements, life span, budget, etc.

The concept report shall address the following:

1. Confirm and document that a problem or need exists and warrants a solution. The originator of the project justification statement shall provide enough documentation that is both concise and clear to satisfy this requirement.

   The project team shall confirm the data provided and begin the process of developing a solution and establishing the “boundaries” to be used during project design and development.

2. Describe what project success looks like. Describing the solution is not needed. Describe or state what will qualify and quantify a successful solution to the stated problem or need.

   Example:
   "The successful solution will improve the level of service of the intersection to Level C."

3. Identify and state what is "known." Clearly identify and list known parameters and data that is available and what decisions are based on. Traffic data, accident history, existing levels of service, public demands, adjacent proposed projects, long term Department goals for corridors, current design policies and practices are all examples of this.

4. Determine solutions to problem: This portion of the concept shall propose possible solutions and vet all feasible solutions. It should be noted that the successful and chosen solution is the one that solves the problem by employing all the flexibility afforded by the practical design process being so defined here.

   Example:
   For the design of intersections, when Intersection Control Evaluation (ICE) analysis recommends a roundabout, ensure that the mini roundabout is considered. Mini roundabouts perform the same functions as standard roundabouts and have significant benefits in cost and impact reductions. Their small size may minimize right of way, environmental impacts, and utility relocations.

5. Project Design Life: A statement documenting the design life of the project and justification for that value/number shall be plainly stated.

6. Design elements consideration: Document in clear concise language the evaluation of design elements and reasons for selecting design criteria.

7. Design variance or exceptions, documentation and approval at concept stage: Any design variances or exceptions that are deemed warranted and justified in order to design the most practical solution shall be listed here and attached to the concept report.

   Example:
   Bridge hydraulic design year storm freeboard clearance criteria may warrant a design variance when there is no documented history of overtopping, a significant increase in elevation cuts off more flow over roadway and would not meet FEMA no-rise, a significant increase in elevation impacts commercial businesses, etc.

   Comprehensive evaluation and documentation to formalize a design deviation, variance or exception is necessary to avoid later discussions and reversal of decisions that cause a project to lose valuable time due to the need for redesign.

8. Define the scope of the project: Clearly define and document the scope of the project and the reasoning for why the scope and limits were set. This is extremely important! Any obvious scope "creep" that might be proposed later should be evaluated and discussed. The reasoning for not including suggested additional scope should be documented.

9. Determine the PDP and preliminary engineering scope of work: Define and document known deviations from the normal GDOT PDP that will be employed.

   Examples of this might be:
   - 20-year forecast of traffic volumes for a project whose lifespan is five years.
   - Value and need for soil survey.
   - Value and need for existing pavement evaluation.
   - Environmental streamline for categorical exclusion (CE) and specifically for programmatic categorical exclusion (PCE).
   - Utilizing environmental programmatic agreements.
   - Streamline plan reviews with field plan review (FPR) email reviews.

   Example:
   Traffic analysis is often required for determining acceptable level of service, traffic signal phasing, pavement design, detour sufficiency, and other key criteria. However, several types of projects do not require these detailed analysis as it is already determined by the type of project. Removing traffic analysis from the plan development process for such projects can reduce overall project duration and complexity.

10. Constructability: Can the concept solution be constructed? The Project Team as part of the Concept Phase, shall review each of the potential concept alternatives for constructability issues Discussions of all known constructability issues, any special construction techniques, or special staging phases required of the concept alternatives shall be documented. Constructability of a project is critical in determining the most cost- effective solution, as long complicated staging to a "simple solution" can add both time and cost to the project.

    Example:
    Evaluate use of Full Depth Reclamation (FDR) in widening corridors where the pavement evaluation requires full replacement of the pavement on roads with limited profile changes. FDR can be completed with day time and/or night time lane closures under traffic on lower volume roads. On high volume road, FDR can be completed at night, in small sections that can reclaim the existing pavement and place the required asphalt over the FDR prior to rush hour,

allowing all lanes to reopen for rush hour traffic. While FDR in small sections is not ideal for reducing construction costs, the expense may be offset by the shortening the project duration. Complicated staging, the right of way footprint, and the use of temporary construction components may be reduced or avoided.

11. Maintainability: Does the concept solution limit proper maintenance or create future maintenance issues and added expense? Solutions that minimize ROW, pull slopes in and require protecting with guardrail are cost-effective and meet project goals, but may limit access for maintenance able if there is no access.

12. Cost estimate: A well-thought out cost estimate including detailed anticipated costs and documented expected savings based on the decisions that lead to the chosen solution.

iv. Preliminary and Final Design

1. Preliminary Design
   - *Design element consideration* plays a critical part of any practical design approach. Practical design is a “design up” approach, not a “strip down” process. Instead of starting with the desired level of improvement and removing items until the project meets a determined budget, the project team must look at existing conditions and design improvements that meet the project’s justification statement.

     Therefore, it is imperative that design elements are selected in a manner that fits the context of each specific project. The Georgia DOT DPM, as well as the 2018 Green Book, provide the design engineer with a flexible framework by which design criteria may be selected. Both policies encourage flexible design utilizing engineering judgement to determine the appropriate level of design needed to meet the project-specific conditions. The use of design deviations, design variances and design exceptions are encouraged when used in appropriate situations to achieve this flexibility.

     Example:
     The DPM, Section 7.2, states that right turn lanes should be placed at paved public streets for projects with design speeds ≥ 45mph. Consider a project that parallels a railroad for multiple miles where the existing pavement and alignment are to be retained as much as possible. The addition of right turn lanes would cause a major shift in the existing alignment to provide sufficient space to construct. The shift in alignment dictates additional right-of-way and causes displacements that could otherwise be avoided. Section 2.1.1 of the DPM specifically allows for flexibility and deviation from the manual when “should” is used. What is the proper design? The right turn lanes should only be installed where warranted and practical.

* *Scope Conformance Review* is an informal process where the engineer of record (EOR) reviews the project plans at various stages (geometric review, PFPR, etc.) throughout preliminary design. The focus of this review is to confirm the plans meet, but do not exceed, the stated needs and goals listed in the project justification statement and approved concept report.

* *Constructability and Maintainability Review* during preliminary design plays an important role in determining the overall project footprint and important details about scope of work to be performed that are oftentimes not addressed during concept development. A thorough and comprehensive constructability and maintainability review from the project team will benefit each individual project by allowing the team to evaluate innovative construction methods to ensure the project can be constructed in the most cost-effective manner, with the least impacts to adjacent properties and utilities.

  This is also another opportunity for the team to review scope conformance, as many wants add complexity to the overall staging of the project. It is important to guard against scope creek and bolting on of "wants" to the project.

* *A detailed quantity and cost estimate* during preliminary design is necessary to ensure the project cost is within tolerance of the planning budget set for the specific project. All known items shall be quantified, and updated unit costs applied to each of the items.

2. Final Design
   * *Scope conformance review* continues to be necessary in the final design phase as an informal process where the engineer of record (EOR) reviews the project plans at various stages (FFPR, etc.) throughout final design.

     The focus of this review is to confirm the plans meet, but do not exceed, the stated goals listed in the project justification statement and approved concept report. Oftentimes additional scope of work is added throughout the life of project development; therefore, it is critical that a review and vetting of scope is completed in final design.

D. Measuring Success

While the obvious implications of the implementation of a practical design program are cost savings to the project and, by extension, the program, there are several other measurable benefits that should present themselves. By monitoring these metrics, overall compliance with the goals of the program may be gauged.

Potential practical design metrics include:

i. *Reduction in project cost in general*. Because individual aspects of the proposed project will be weighed against specific needs and purposes of the project, it is anticipated that several design aspects will be reduced or eliminated altogether. As a result, it is expected that average projects costs by type of project should be reduced.

ii. *Reduction in major swings of estimated costs through the life of a project*. Currently estimated construction costs may change dramatically over the course of the design phase. However, if design aspects are limited to the original need and purpose of the project without increases in scope, it is expected that the change in project costs during the design phase of the project should be reduced.

iii. *Reduction in letting delays*. Many projects are delayed in the design phase due to ROW, utilities, environmental or scope changes. With a minimization of footprint in general and reduction of scope change through the design life of the project, the risk of each affecting the overall schedule during the design phase is reduced. As a result, it is expected that schedules should be more consistent and more easily adhered to.

iv. *Reduction in schedule for some types of projects*. Closely related to the previous metric, it is also expected that the use of more focused need and purpose to reduce or eliminate scope creep would reduce the amount of time in general for the design phase. In addition, because of the targeted nature of scope of each project, steps may be eliminated from the PDP based on intended scope. As a result, it is expected that for some types of projects that may allow for a reduction in PDP, a reduced design time may be presented.

v. *Increased implementation of flexibility through increase in number of design exceptions (DEs)/design variances (DVs)*. Currently the Office of Design Policy estimates that the Department processes up to 150 design variances each year. Based on the current number of active projects and an average design life of four years that roughly translates to one design variance for every two projects on average. It is anticipated that a departure from standards-based design would dramatically increase the number of design variances submitted for each project.

vi. *Increase in program safety*. Currently it is very common to purposefully increase the scope of a project so that nearby deficient existing features might be improved regardless of benefit-cost to the project or program overall. Very often these scope increases occur because the feature in question is below the benefit-cost needed to recommend improvement as a stand-alone project.

This, in turn, increases the cost of the individual project and ensures that the program consists of fewer projects than it otherwise would. A firm adherence to the planned need and purpose of the project would mean that overall costs remain lower, allowing more flexibility to apply remaining funds to improve features with higher benefit-cost.

vii. *Greater benefit-cost per project and/or design feature*. With the overall cost of the average project expected to be reduced through a greater conformance to the need and purpose (or benefit), it is therefore expected that the benefit-cost of each project should be increased after the implementation and adoption of a practical design program.

5. Case Studies

Example A: Practical Design Approach – State Route 18 @ State Route 41 – Meriwether County

The intersection of SR 18 and SR 41 in Meriwether County has had a long history of severe crashes. Between the years 2012-2015, the intersection experienced five angle crashes that resulted in nine injuries and one fatality. As a result of this crash history, district personnel developed a plan to directly address the crash history by utilizing a practical design approach.

Practical Design Solutions

- Utilized a 110 ft. inscribed circle.
- Staged the project by closing the western section of the intersection (slip ramp for southbound to westbound traffic) and constructing most of the project within that area, keeping the remaining roadways open to traffic.
- Lighting consisted of five poles.
- Utilized all rural shoulders with no curb and gutter or closed drainage system – installed truck blisters on outside approaches to address shoulder rutting.
- No required right of way (ROW) was needed – opted to realign Cedar Rock as a T-intersection with SR 41 just south of the roundabout, instead of including it in the roundabout intersection. This allowed the project to remain within the ROW.
- Scaled down plan set consisted of six plan sheets provided to contractor design team. (typical sections, plan sheet, lighting plans, no profiles, no cross sections). Design was done in-house with less formal plan reviews to accelerate preliminary engineering (PE) timeframe.

By utilizing a practical design approach, this project was constructed for a fraction of the cost of the average roundabout. Since the roundabout was constructed in March 2015, there have been zero angle crashes and zero fatalities.

Example B: Practical Design Approach – County Road (CR) 180/Liberty Church Road at Little Hurricane Creek – Bacon County

The Low Impact Bridge Program (LIBP) project is located on CR 180/Liberty Church Road at Little Hurricane Creek approximately 10 miles northwest of Alma in Bacon County. This project consists of replacing an existing 22 ft. x 60 ft. bridge. The existing approach roadway is a 22 ft. wide dirt road on 36 ft. to 80 ft. of existing right of way. The posted speed is 35 mph.

The bridge needed to be replaced due to its low sufficiency rating of 36.71 and superstructure and substructure structural deficiencies. The goals were to replace the structure with minimal approach road construction, no required right of way or easements and detour traffic off-site during construction.

The project constructed a 26.75 ft. x 100 ft. replacement bridge. As part of the bridge replacement, 492 ft. of roadway approach was reconstructed. The roadway consisted of 10 ft. travel lanes with 2 ft. grass shoulders in each direction. The shoulder widths vary from 2 to 7.5 ft. to accommodate guardrail and anchorages. Permanent easements, up to 18 ft. wide, were required in each quadrant of the project to accommodate the proposed bridge project construction.

The project documented design deviations (DDs) for horizontal and vertical alignment geometry in order to keep roadway approach construction to a minimum, avoid required right of way and minimize construction easements. The roadway ADT was low volume and adhered to AASHTO Guidelines for Geometric Design of Very Low Volume Roadways. Substandard K values and curve radii were documented as DDs since there was no history of accidents related to alignment geometry and standard stopping sight distance was achieved.

The design solution involved utilizing DDs to document non-standard geometry in order to meet the need and achieve the goals of the project. The goals achieved were to minimize roadway approach, avoid required right of way and detour traffic offsite. The project costs would have been higher without DDs.

The positive result of the solution and outcome allows bridge replacement funding to be spent on more bridge replacement projects throughout the State.

Example C: Practical Design Approach - Pavement Design for an Operational Improvement Project

Project Description: This project proposed to improve the interchange of I-285 and State Route 6 (Camp Creek Parkway). The selected alternative proposed to construct a diverging diamond interchange (DDI) at this location and make improvements to Camp Creek Parkway if required to accommodate that configuration. The existing bridge would be maintained in place, lifted to meet vertical clearance requirements and widened to accommodate the design of a DDI.

Need and Purpose Description: This project was justified by the need to improve operations and reduce delay associated with congestion in the I-285 at SR 6 area and to minimize back-ups onto the I-285 mainline.

Proposed Practical Design Implementation: After the completion of a pavement evaluation, it was recommended to replace the pavement along SR 6 (Camp Creek Parkway). It had been determined through the review of cores that the pavement structure was insufficient to maintain the traffic levels projected for SR 6. This recommendation would cause a substantial increase in design and construction effort in order to stage the full depth reconstruction of each lane while maintaining a minimum level of lanes during construction.

Ultimately, the option of pavement rehabilitation was not included on this project, but suggested to be completed under a separate project for the following reasons:

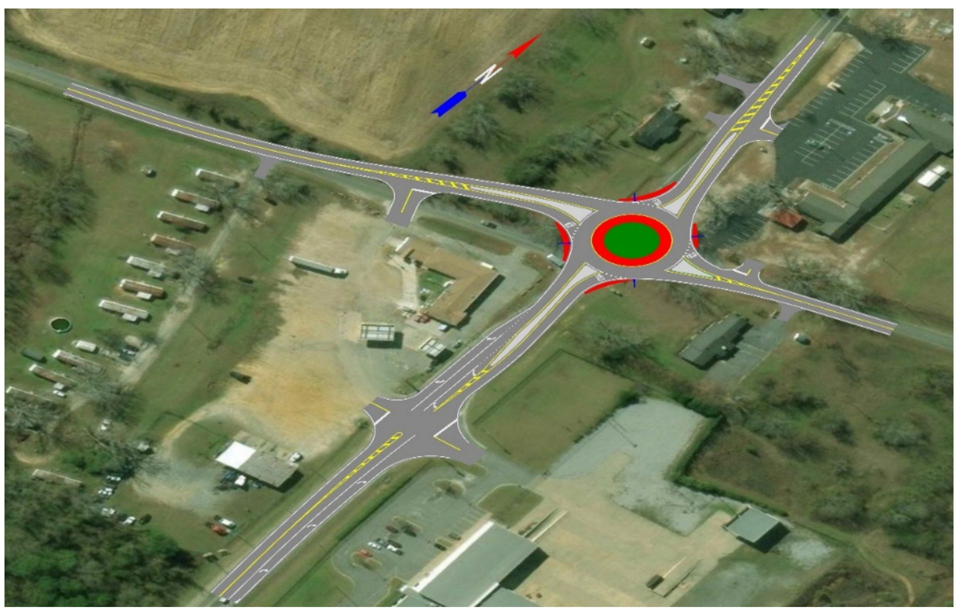
1. Pavement rehabilitation was not an original goal of the proposed project.
2. Pavement rehabilitation would cause significant delays to the schedule.
3. The inclusion of pavement rehabilitation would substantially increase the cost of the project.
4. Pavement rehabilitation was needed for the corridor and not just the area of the interchange. The benefit of pavement rehabilitation would be limited, since the footprint of the project was limited to the interchange itself.

Savings: In addition to the avoidance of schedule delays, additional design effort and rework and substantial construction staging, the use of existing pavement saved approximately $4.3 million in pavement costs alone when compared with the full depth option for this interchange.

Example D: Practical Design Approach - Pavement Design – State Route 257 @ Pinehill Road/Waldrep Road – Laurens County

The intersection of SR 257 and Pinehill/Waldrep Road in Laurens County has a history of lengthy time delays for traffic making left turns from the two county roads. Pinehill Road and Waldrep Road were offset in alignment from each other, which added to the difficultly of the operations at the intersection. West Laurens Primary and Middle schools are located off Pinehill Road along with all the West Laurens School system sporting complexes. West Laurens High School is located south of this intersection off State Route 257. All school traffic traveling form one school to the other passed through this intersection. The intersection often experienced lengthy vehicle queues and delays on Pinehill Road due to vehicles making left turns to go south on SR 257.

Laurens County Board of Commissioners approached GDOT wanting to partner to construct a roundabout. The county also wanted to begin construction of the roundabout as soon as possible. Laurens County had $300,000 of local funds that they pledged to the project. They agreed to purchase all ROW with this local funding through a Local Government Agreement and provide GDOT with the remaining funds of the $300,000 after ROW was purchased to use toward construction.



<u>Practical Design Solution</u>

- Utilized a 140 ft. inscribed circle.
- GDOT oversaw the design, let and construction of the roundabout.
- Laurens County would acquire all needed ROW and easements
- Rural shoulders with no sidewalk or closed drainage was used. Pedestrian patterns were analyzed, and pedestrian facilities were not justified.

- Truck blisters were used in the radii of all four quadrants.
- Lighting consisted of four street light fixtures on poles located in all four quadrants and installed by the local Electric Membership Corporation (EMC) at an installation cost of $2,500.
- Laurens County will pay power cost for the lighting at a rate of $900 annually and the EMC will maintain the lighting.
- A condensed project schedule was generated that would carry the project from concept to let in 12 months. Some deviations from the PDP occurred, such as only holding a construability review in lieu of a preliminary field plan review (PFPR).
- Manageable risk was incurred throughout the entire design phase of the project due to the condensed schedule. Many project tasks overlapped that typically don't in a project schedule and the project was designed to a minimal required ROW footprint that was set within the first month of the design phase.

Results

The project was let in August 2019 at a cost of $1,472,900. The project went from concept to let in 14 months with no delays in the design of the project. The delay in the schedule was a result of working to acquire one outstanding parcel that was not within the control of Georgia DOT or Laurens County, but was tied up in federal court seizure proceedings.

Example E: Practical Design Approach – SR 219/River Road at Schley Creek – Muscogee County

This project is located approximately 10 miles North of the City of Columbus, Georgia in Muscogee County. This project consists of replacing an existing 34.30 ft x 240 ft bridge with a new 43.25 ft x 270 ft bridge on an offset alignment to the east, which avoids and minimizes impacts to federally protected species, streams, and numerous wetlands. The existing approach roadway is 28 ft with an existing right of way width varying between 60 ft – 130 ft. The posted speed of the roadway is 55 mph with 2016 (Existing) ADT of 4,150 and 2040 (Design Year) ADT of 5,275. The roadway has a 24-hour truck traffic of 14.5%.

The existing roadway segment attributes provided minimal shoulder widths combined with steep roadway grades around the area of the bridge. The programmed need and purpose of this project was to replace the deficient structure. While the team investigated methods of meeting the project goals with minimal road construction, the initial design included improvements to crest vertical curves and increased shoulder widths, lengthening the project limits outside the required area to replace the bridge and meet the need and purpose.

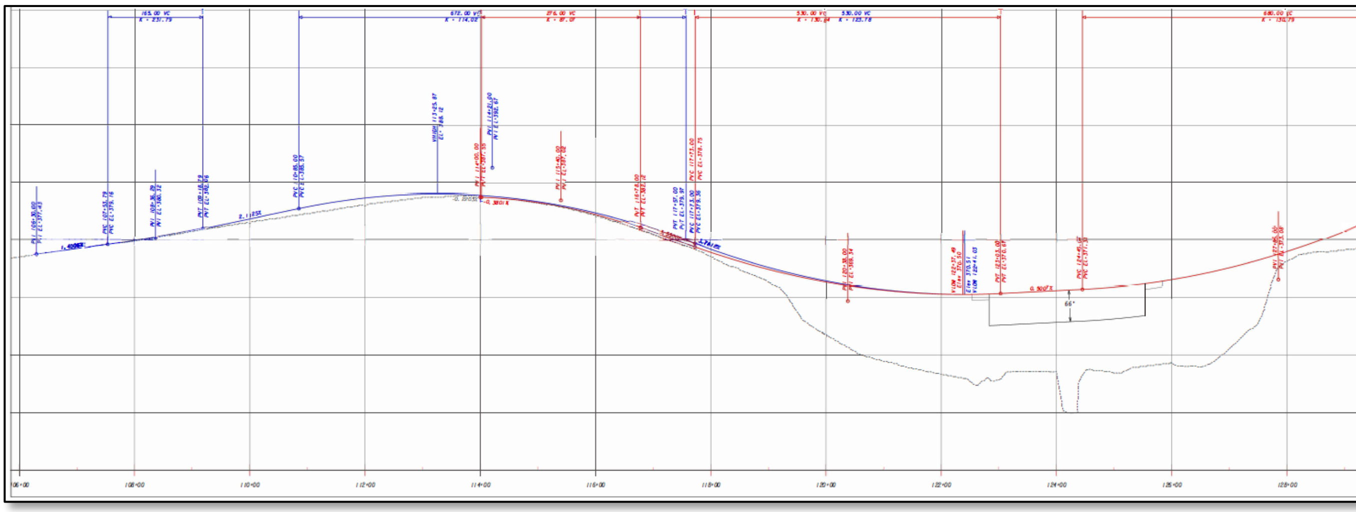
After the right of way was authorized the design team considered practical design related to the proposed improvements to the roadway segment. It was determined that the roadway segment improvements could be reduced as the project enhanced existing substandard horizontal curves, variances for vertical stopping sight distance and maximum vertical grade could be provided to reduce the length of the project outside that of the need and purpose.

The practical design measures were considered viable, mitigations included signage for steep grades and limited sight distance and the design was revised to include, walls and guardrail, and embedded guardrail anchorages, which reduced the project footprint, maintaining clear zone requirements, and avoided impacts to existing steep cut and fill slopes.

This practical design change provided significant construction cost savings while meeting project goals. As compared to meeting all standards and design criteria and by implementing variances and site-specific considerations, the project:

- Reduced total project length by approximately 800-ft.
- Reduced total required right-of-way and permanent easement acreage by 50% and 70%, respectively.

Figure 1: Profile Comparison Between Meeting All Criteria and Practical Design



Meets All Criteria **Proposed Practical Design Approach**

The positive result of these solutions and outcome will allow bridge replacement funding to be spent on more bridge replacement projects throughout the State. Not capturing this early, during the concept phase, resulted in late changes to right of way plans and substantial redesign efforts potentially jeopardizing fiscal year programmed funding.

6. Suggested Questions to Ask

Planning

- Why is the project needed?
- What is the problem?
- What is the goal of the project?
- What does success look like?
- What is the life span of the project?
- Is the project budget realistic? If not, why?
- How was the project budget established? Cost per mile, similar project comparison, local, etc.
- What are the stakeholder needs, and do they meet the goals of the project?
- Does the project include any wants/desires that are not necessary to meet the needs or goals of the project? If so why, and can they be removed?

Concept

- Who is the project team and are they engaged?
- How does the solution address the problem?
- Is the solution the most cost-effective?
- How does the solution consider future maintenance costs?
- Does the solution meet the expected life span?
- What were the design variances/exceptions that were evaluated as part of the different concepts?
- What coordination with other programs/projects have occurred?
- How does the solution meet stakeholder goals?
- What were the constructability issues that have been evaluated?
- What were the environmental issues that have been evaluated?
- What avoidance and minimization measures have been considered for utilities, ROW and environmental, etc.?
- Are there any wants/desires included that are not necessary to meet the needs and goals of the project? If so, remove or provide justification to include those.

Design

- What internal value engineering effort has been performed by the project team?
- Have all constructability issues been resolved?
- What avoidance and minimization measures have been considered for utilities, ROW and environmental, etc.?
- How does the design solution solve the problem and meet the goal?
- Are there design elements proposed that are beyond the goal?
- Does the solution meet the stated life span?
- Does the solution exceed the stated life span?
- What coordination with other programs/projects has occurred?

Appendix A: Recommended Project Justification Statement Development Template

A concise project justification statement should focus on the main transportation problems to be addressed. Use the information in the following steps to assist with the development of the project justification statement:

1. *Identify the current conditions.*

Establish the existing conditions at the specified location. Some of the necessary information may include the following:

- Stop conditions
- Lane configuration
- Adjacent roadside objects and facilities
- Terrain
- Existing ROW
- Additional necessary information

2. *Determine the existing deficiencies.*

Determine the existing deficiencies at the location. The type of project will determine the data needed to develop the project justification statement. Gather enough information to provide a baseline for the project team to measure improvements. To effectively determine where you want to go if you need to know where you are.

3. *Identify the deficiencies that need to be improved.*

Determine which of the existing deficiencies will be improved as part of the proposed project. Focus on the needs of the stakeholders and the improvements that will yield the highest returns.

4. *Determine the project goals.*

Determine the extent of the improvements for each identified deficiency. This becomes the project goal and all proposed improvements will aim to achieve it. The goals must be set to maximize investment returns.

For example, if the current LOS for a mile stretch of freeway is F, you may want to set the project goal at LOS C. LOS C may be ideal, but due to resource restraints and other system wide improvements that can yield higher returns of investment, the goal may be best set to LOS D or even LOS E.

Look at the surrounding area to determine practical goals. Is improving beyond LOS E for this mile adding the desired value to the system if the LOS of the previous three miles is E, and the three miles afterward is E?

5. *Clearly and specifically describe the justification statement of the project.*

Develop a clear and specific statement describing the needs and goals for the project once all deficiencies and project needs and goals are determined. This statement will be the focus of all design efforts throughout the project.

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