1000 Performance Based Project Development (PBPD)

Table of Contents

1000 Introduction 1

1001 Application to the PDP 1

1001.1 Planning 2

1001.2 Preliminary Engineering 3

1001.3 Design 4

1002 Evaluation of PBPD Options 5

1002.1 General 5

1002.2 HSM for Evaluation 5

1003 PBPD Examples 6

1003.1 Secondary Needs 6

1003.2 Design Year/LOS 6

1003.3 Bottleneck Projects 7

1003.4 Context 7

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1000 Performance Based Project Development (PBPD)

1000 INTRODUCTION

Performance Based Project Development (PBPD) is a planning and design philosophy being promoted by the Federal Highway Administration (FHWA) and State Departments of Transportation. The general premise of PBPD is that proposed improvements should be targeted and right sized based on project specific needs.

This philosophy places less emphasis on strict adherence to standards and more significance on safety and operational performance. PBPD is a design up philosophy that makes the necessary improvements to a facility to address specific performance issues. The goal of PBPD is to fix what is broken and to not unnecessarily spend scarce resources solely for the purpose of meeting published standards when those deficient features (as defined by our manuals) are not causing safety, operational or similar problems.

PBPD is a philosophy that will permeate every aspect of the ODOT project development process. PBPD is used to right size the initial scope of a project and will continue through preliminary engineering as well as into detail design. The goal of PBPD is to right size a project scope and the subsequent engineering decisions through the application of data, analysis and engineering judgement.

It is understood that no one project is more important than the overall system. Consequently, savings obtained from targeted PBPD solutions on specific projects can be reinvested in the overall system.

In ODOT, the basic tenants of PBPD will be:

- Safety will not be compromised;
- In many cases, the minimum standard will be the existing condition;
- A project Purpose & Need should be focused to address specific problems supported by data;
- Design solutions should focus on adherence to the project Purpose & Need;
- Solutions should be an optimized combination of mobility, operations and other modes;
- Designs should be consistent with the context of the corridor;
- Designs should strive to maximize benefit/cost.

PBPD may be applicable to any project and can occur at various phases of the project development process. Planning, Preliminary Engineering, Environmental Engineering and Design can all afford PBPD opportunities. Some projects will, however, obviously have more potential PBPD possibilities than others. Path 1 projects by their very nature will have limited PBPD opportunities. Conversely, more complex projects will generally have more opportunities for meaningful PBPD considerations.

1001 APPLICATION TO THE PDP

PBPD can happen throughout project development and can be applied to any number of project processes and elements. The key elements to PBPD will be thoughtful application, balanced consideration and documentation. An effort should be made to stay on the existing alignment (vertical and horizontal) to the maximum extent practical when this will allow for the rehabilitation of existing infrastructure (structures, pavements, median barriers, etc.) rather than construct new infrastructure on a different alignment. In all cases, however, the decisions related to PBPD should consider and balance the benefits, disadvantages, costs & impacts.

1000 Performance Based Project Development (PBPD)

1001.1 Planning

PBPD in the Planning phase of a project does not address specific design criteria; rather, it relates to the scope by establishing the Needs of a project. Thoughtful establishment of a project's Needs allows the project to focus on fixing critical elements and save funding by potentially not fixing those elements that aren't deemed to be unacceptably impactful to safety, operations, system conditions, stakeholder concerns or other similar factors.

During the planning phase technical studies will be used to identify those features that are critical and those features that would only be addressed as budget and impacts (benefit/cost) allow. The product of this effort will be the identification of Primary and Secondary Needs that will be incorporated into the project Purpose and Need. Stakeholder involvement can be a useful tool in identifying the context or relative importance of Primary and Secondary needs as identified through technical studies. Subsequent Preliminary Engineering activities such as the Feasibility Study, AER, IMS, etc. would identify solutions to the Primary and Secondary Needs with a determination if the impacts and cost justify addressing a particular Secondary Need as part of the project.

Primary Needs are those elements of a project that are critical for the project to address in order to satisfy the Purpose and Need. Secondary Needs are essentially elements that may or may not be addressed by the project based upon the cost and impacts they create. The technical studies will be the basis to classify a particular need as being Primary or Secondary. In practical terms, Primary Needs are those that the project must address to the extent feasible. Secondary Needs do not rise to the level of a Primary Need based upon the technical studies (ex. Safety, HCS, HSM, System Conditions, etc.), the context of the project or stakeholder concerns and may ultimately not be addressed by the project depending upon their costs and the impacts they create. A project element may not meet existing standards, policy or guidance and still could be considered a Secondary Need if it is not unduly impacting safety, operations, maintenance or stakeholder concerns.

For example, a common application of this might be a Secondary Need to "Improve Existing Geometrics". In this example some of the existing geometric elements within the project limits may not meet full L&D Volume 1 standards but the analysis/technical studies performed to craft the P&N shows that these deficient elements are not creating any undue safety or operational problems. In this situation, the project would strive to improve (design up) those geometric features identified as Secondary Needs until the cost and impacts are deemed to be impractical in terms of benefit/cost. The term improve should be noted as the goal is to make improvements to the extent practical, not necessarily to meet full standards if the cost or impacts outweigh the benefits.

During identification of Needs and the subsequent formulation of the Purpose & Need no decision is made about if the project will address a particular Secondary Need. That determination will be made during Preliminary Engineering through the Feasibility Study and AER (if applicable) when sufficient alternative information is available to make a balanced decision. The level of effort to determine if a Secondary Need should be addressed should be as minimal as possible in order to make an informed benefit/cost decision. In addition to determining the cost/impact ramifications of addressing a Secondary Need, the original technical studies (ex. existing crashes and operational performance) may be referred to as a potential information source when making these decisions. Some decisions will be obvious to a practical person and minimal effort will be required in order to document the decision to not address a Secondary Need.

Establishment of Secondary Needs creates a powerful opportunity in the subsequent Preliminary Engineering phase for PBPD savings in terms of impacts and cost savings.

The following is a non-all-inclusive list of some potential PBPD opportunities for consideration in Planning:

- Addressing secondary needs
- Design Year
- Design Volumes
- Design Speed (Context of Adjacent Corridor)
- Rehab versus replace

1001.2 Preliminary Engineering

Projects should always address the Purpose & Need to the extent practical and possible. This is especially true of the Primary Needs incorporated into the Purpose & Need document. The Secondary Needs, however, represent a significant opportunity to apply PBPD principals in order to minimize impacts or contain costs.

The Feasibility Study and AER (where applicable) is used to evaluate alternatives to address the Purpose & Need. Included should be an assessment of impacts and costs necessary to address Secondary Needs of the project. PBPD philosophy dictates that the benefits of addressing a Secondary Need is balanced against the impacts and costs in order to make an informed decision. When the benefits outweigh the impacts and costs the Secondary Need should be addressed by the project. In those cases when the impacts and/or costs are deemed to outweigh the benefits the project may opt to not include addressing that particular Secondary Need or to make an improvement that falls short of meeting the standard. This same methodology can be applied to any number of potential project elements identified as Secondary Needs.

It will often not be appropriate for PBPD decisions during Planning and Preliminary Engineering to be made unilaterally at the project level. Some decisions could affect subsequent processes or approvals (ex. a Structure Type Study, IMS or Design Exceptions). It is important for evaluations of PBPD decisions in Planning or Preliminary Engineering to include the appropriate disciplines, process owners and approvers in order to avoid potential back tracking later in the development process. The owners of those subsequent decision points should be involved in the evaluation and acceptance of PBPD decisions during Planning and Preliminary Engineering. For example, an interchange improvement may identify improving one specific movement as being a Primary Need. The Office of Roadway Engineering (ORE) is responsible for the eventual approval of the subsequent IOS/IMS. In this case ORE should be involved in the decision to not address the other movements in order to avoid potential back tracking during evaluation of the IOS/IMS.
The following is a non-all-inclusive list of some potential PBPD opportunities in Preliminary Engineering:

- Operational Performance
  - LOS Criteria
  - 600’ of Access Control along the crossroad for diamond ramps
- Alternatives
  - Facility Type (expressway, freeway, super 2, etc.)
  - Grade separation versus unconventional intersection
- Geometrics
  - Ramp Terminal Spacing
  - Removal of inside merges
  - Removal of left exits or entrance ramps

1001.3 Design

Design in this context refers to Stage 1, Stage 2 and Stage 3 plans. As such, Design centric PBPD opportunities can occur during Preliminary Engineering, Environmental Engineering or Final Engineering depending on the project path/PDP requirements.

PBPD Design is a "design up" philosophy rather than the traditional approach to make every facet of a facility meet every standard even when those deficient standards (as defined by our manuals) are not causing any operational or safety problems.

PBPD in Design is typically associated with meeting specific geometric design standards and guidelines. The application of PBPD in Design requires a departure from the traditional mentality that meeting design standards is a metric, either formally or informally, to measure the success of a given design. Meeting standards is a worthwhile goal, however, in many instances the cost of meeting all of the design standards can be prohibitively expensive or impactful; sometimes to upgrade substandard geometric features that are not causing undue problems.

Design has formally recognized the concept of PBPD for a very long time through the Design Exception (D.E.) process. Where it is not practical to meet one of the Controlling Criteria due to various impacts and/or costs, a Design Exception is a formal approval process to evaluate and document the decisions (Refer to L&D Volume 1, ***Section 105***). Design Exceptions will continue to be the primary method to document deviations from the Controlling Criteria during Design. Deviation from other Design criteria (non-Controlling Criteria) that do not require Design Exceptions should also be evaluated and documented throughout project development.

It should be noted that application of PBPD in Design can still be beneficial when addressing Primary Needs of the project. The project can still address the Primary Need while reducing impacts and/or costs through the application of Design based PBPD to specific design criteria related to the Primary Need.

Proposed deviations from standards, policies and guidelines must be balanced decisions that considers the potential advantages and disadvantages of the proposal. The decision should be based when appropriate upon a quantitative comparison potentially including historical crashes, predicted crashes (HSM), capacity analysis (HCS), turn and vehicle tracking and similar methodologies. The analytical effort should be commensurate with the proposal and in all cases should be documented. For proposals requiring deviation from Controlling Criteria, a Design Exception will be required.

The following is a non-all-inclusive list of some potential PBPD opportunities in Design:

- Geometrics
    - Typical/ Cross Section (for both cost/impact avoidance or context)
    - Median width
    - Roadside grading (safety, clear zone, common or barrier)
    - Cross slope corrections
    - Upgrading entrance ramp terminals including additional acceleration length if needed
    - Upgrading exit ramp terminals by providing the standard diverging curvature
    - Providing the minimum ramp design speed

1002 EVALUATION OF PBPD OPTIONS

1002.1 General

PBPD decisions should be informed, weighing both the positive and negative impacts (B/C). There is no single process that can be used to evaluate PBPD opportunities. The evaluation methodology and level of effort should be commensurate with the complexity of the situation. When appropriate, decisions should be based on comparative quantification through the use of HCS, HSM, vehicle tracking (for narrow lanes), simulation, technical studies, or similar evaluations.

The level of analysis should be commensurate with the proposal and the facility type. For example, the level of analysis to "squeeze in" an additional interstate lane with resulting narrower lane and shoulder widths would be significantly higher than a proposed spot narrowing of a shoulder underneath an overhead structure.

The historical approach of absolute adherence to standards has primarily been used as a proxy measure of a design's expected safety performance. With the advent of the Highway Safety Manual (HSM) and its predictive safety performance methodologies we can now quantify the expected ramifications of many PBPD opportunities.

1002.2 HSM for Evaluation

HSM is an analytical tool, which in some cases, can be used to compare the expected crashes between different alternatives. HSM, like other analytical tools, should not normally be the sole basis of making decisions. It can, however, be a factor providing a quantified comparison of potential safety performance in terms of expected crashes.

When appropriate and when the situation does not exceed the capabilities of the software (ECAT) or research data set, HSM can be used to compare expected crashes between alternatives. Safety should always be an important consideration, however, that does not mean an HSM analysis cannot predict an increase in crashes on any proposed alternatives. The question becomes what is the magnitude of the predicted crash increases and what are the associated severities.

For example, it may be perfectly appropriate for a PBPD alternative to accept a modest increase in property damage (PDO) crashes if the offsetting benefits afforded by the alternative are commensurately high.

Below is an example HSM analysis for a pilot PBPD project where:
KA= Fatalities and Incapacitating Injuries; B= Visible Injuries; C= Non-Visible Injuries; O=Property Damage

Project Summary Results (Without Animal Crashes)	KA	B	C	O	Total	*Crashes Per mile
Npredicted - Existing Conditions	0.6030	2.1520	2.3725	10.6309	15.7585	
Npredicted - Proposed Conditions	0.7413	2.5861	2.8332	12.9360	19.0967	
				Difference	3.3382	21.2%

Project Summary Results (Without Animal Crashes)	KA	B	C	O	Total	*Crashes Per mile
Npredicted - Existing Conditions	0.6030	2.1520	2.3725	10.6309	15.7585	
Npredicted - Proposed Conditions	0.4445	2.3177	2.5450	12.7505	18.0577	
				Difference	2.2993	14.6%

Countermeasures installed:		
Rumble Stripes	Source:	HSM Supplement
Wider Pavement Marki	Source:	http://library.modot.mo.gov/RDT/reports/Ri06043/cm12002.pdf
Lanes Narrow signage	Source:	None. Assumed small crash reduction

It should be noted that an increase to the expected crashes predicted by HSM may be potentially mitigated with the application of appropriate safety countermeasures. These countermeasures should be factored into the HSM analysis. In the above "Project Summary Results", the difference between the upper and lower comparisons is the lower has incorporated Safety Countermeasures to reduce the number of predicted crashes.

Refer to the Safety Analysis Guidelines maintained by the Office of Program Management for detailed analysis requirements.
http://www.dot.state.oh.us/Divisions/Planning/ProgramManagement/HighwaySafety/HSIP/SafetyAnalysisGuidelines/Safety_Analysis_Guidelines.pdf

1003 PBPD EXAMPLES

1003.1 Secondary Needs

Design preference is for ramps to enter/exit from the right hand side due to driver expectation. Converting a left hand ramp to a right hand ramp can be costly or impactful. It might be considered a Secondary Need if the existing left hand ramp is not causing undue safety or operational problems. If the project has interest in potentially retaining a left hand ramp a technical study should be conducted during Planning to determine if the existing left hand ramp is causing undue safety or operational problems. Based upon the results of the technical studies, the project may potentially determine that relocating the ramp to the right side is only a Secondary Need of the project.

The Feasibility Study and/or the AER would determine the actual potential impacts and costs of switching the ramp to the right hand side. A determination about the project addressing this Secondary Need would be made based upon the impacts and costs versus the benefits (B/C).

1003.2 Design Year/LOS

A PBPD Preliminary Engineering opportunity could be related to the proposed alternatives and Design Year/Level-of-Service (LOS) requirements. For example - an expressway with at-grade signalized intersections is suffering from congestion and congestion related crashes. A Primary Need of the project might be to improve corridor capacity. Note that the Primary Need is not to meet a specified LOS, but to improve capacity. This provides for flexibility in identifying and evaluating alternatives. In these types of situations it would traditionally be common and logical to propose variations of grade separations as the alternatives. The cost of these new interchanges could, however, be prohibitively expensive with little likelihood of funding being available for the foreseeable future.

A PBPD alternative might be to also propose alternative intersection designs such as a Superstreet signalized intersection. The Superstreet operation would not provide the same capacity as a grade separation and it might not potentially meet Design Year LOS criteria, however it does meet the Purpose and Need of the project by improving corridor capacity. It could work acceptably for many years and it would provide significant capacity improvements as compared to the existing (no-build) traditional traffic signals. The Superstreets would also be much less expensive and have the potential to obtain the necessary construction funding. In this case, the Superstreet meets the Primary Need (though not to the extent of a grade separation) by improving corridor capacity but it could potentially fail to meet 20 year LOS criteria. In the context of PBPD, a determination would have to be made if the benefits provided outweigh the costs and impacts of the grade separation.

1003.3 Bottleneck Projects

Bottlenecks are capacity constraints typically contained in a fairly small geographic area. They can be caused by insufficient capacity due to the number of basic mainline lanes, weaves, merges or other geometric features that cause traffic operational problems.

A potential PBPD solution might be to “squeeze in” an additional lane which may result in less than standard lane widths, shoulder widths or barrier offsets. The Performance of the proposed resulting typical section would be the basis of determining if this type of alternative should be approved, specifically:

1. Capacity analysis can be used to predict the operational benefits;
2. HSM can be used to predict the expected safety performance of the proposed typical section versus the existing (example – expected crash performance related to narrower lanes, shoulders and offsets to barriers versus benefits from reduced congestion);
3. Design vehicle tracking could be investigated to ensure there is not infringement on adjacent lanes;
4. Investigation of hydraulic spread on a reduced shoulder width could be necessary;
5. Others analysis and considerations as the situation and proposal require;

Like all PBPD decisions, the results of the alternative analysis would be the basis of deciding if the benefits of a “squeezed in” lane outweigh the negatives.

1003.4 Context

PBPD can be applied to establish a project’s design criteria based upon the surrounding context or stakeholder input. An example of this might be a corridor that is winding with narrow lanes and shoulders throughout its length. It may not make sense and may potentially be prohibitively expensive and impactful to improve one section of that roadway to meet full geometric standards. In this case, the project might set geometric goals to improve the geometric design to a practical extent while not attempting to meet full standards. In the end, the corridor will always be a winding road with little likelihood of ever being relatively straight and flat (meeting our standards). Meeting standard in one small section of the corridor, far exceeding the context of the rest of the corridor, might provide relatively little benefit at a relatively large expense. The cost of fully meeting standards would deprive the necessary construction funds from being available to meet other system needs.

It may be practical and appropriate to set design criteria, operational performance requirements and other project level metrics based upon the context of the corridor as well as stakeholder input.