

# PCPS – A Part of the Pavement Management Toolkit

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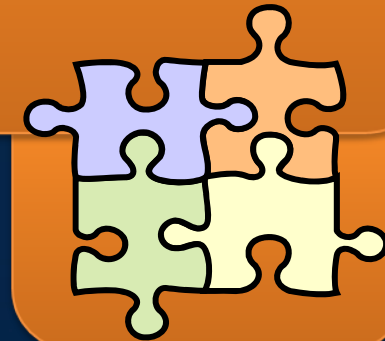
# Outline

- Pavement Management
  - PCPS as a key tool
- Concrete Pavement Repair and Rehabilitation
  - Design
  - Selection criteria
    - Life cycle cost analyses
- Concluding Remarks



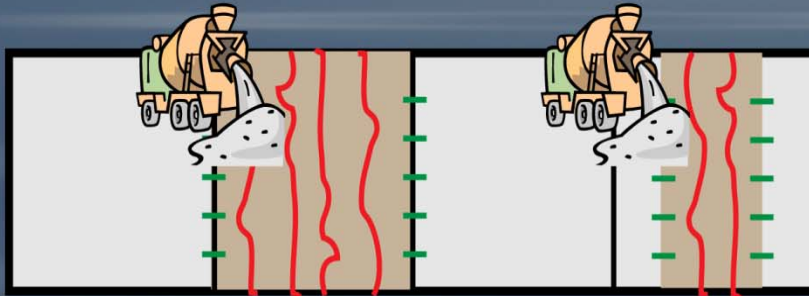
## Pavement Management..

*...is a coordinated systematic process for carrying out all activities related to providing pavements.*

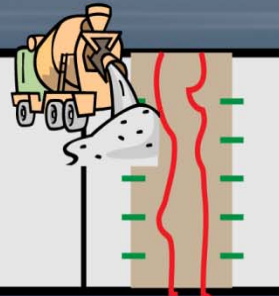


# Applications

Slab replacement



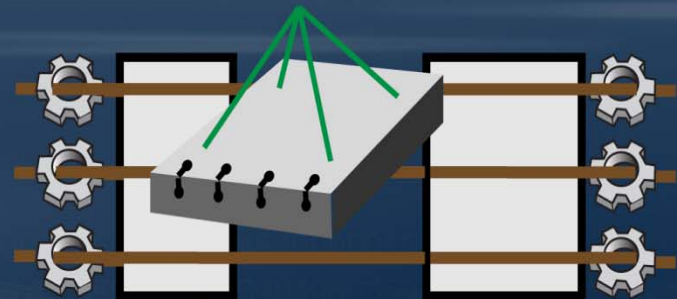
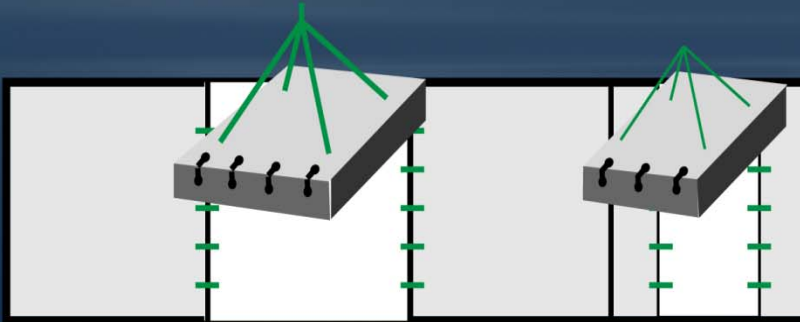
Full-depth repair



Conventional paving



Conventional



PCPS

Rehabilitation

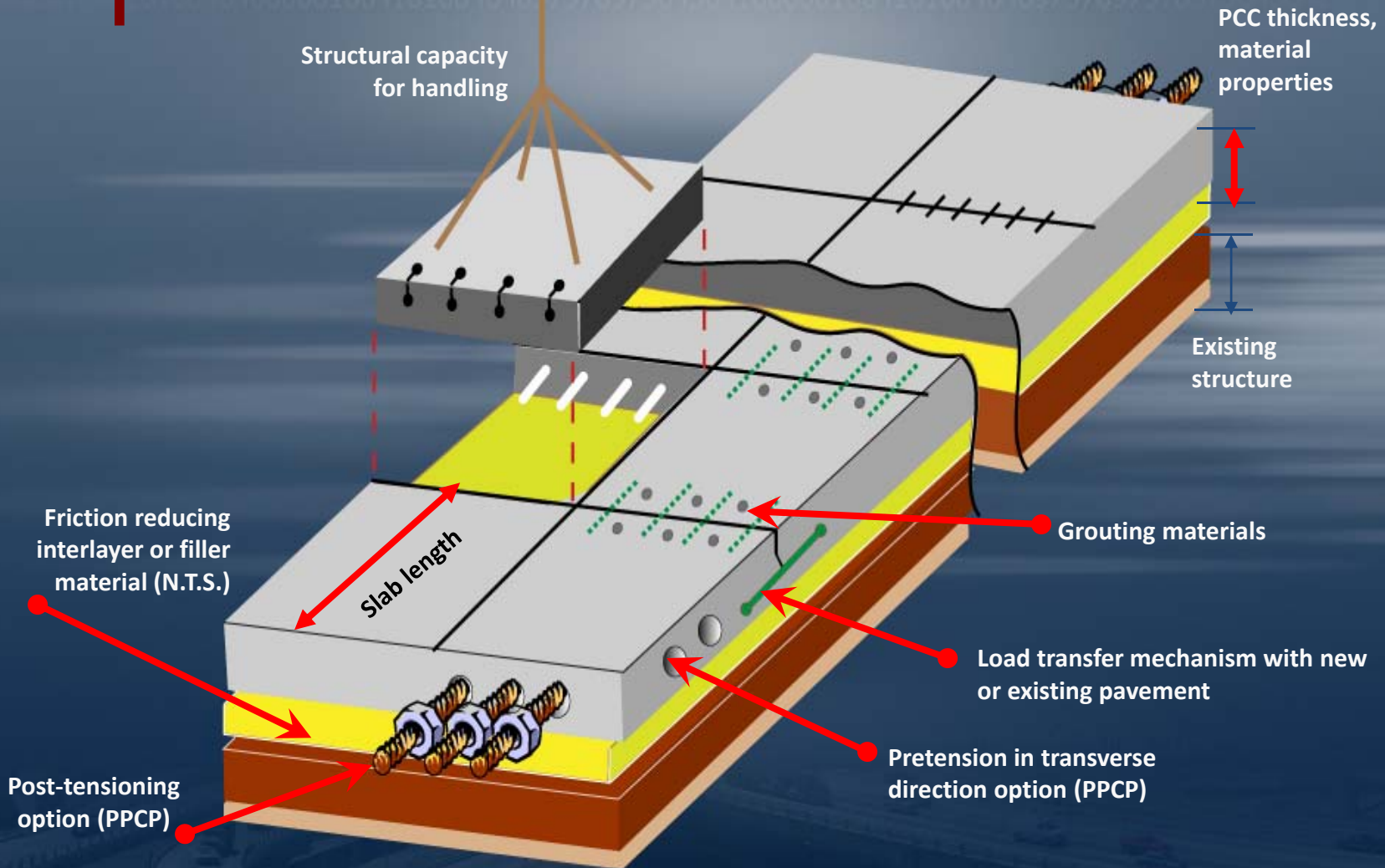
Post-tensioning (optional)  
New Construction



# Objectives of Pavement Design

- To provide a surface that is:
  - Strong
    - Structural capacity (materials and thickness)
  - Smooth
  - Safe
    - Friction
    - Drainage
  - Economical
    - Initial construction cost
    - Recurring maintenance cost

# PCPS Design Components

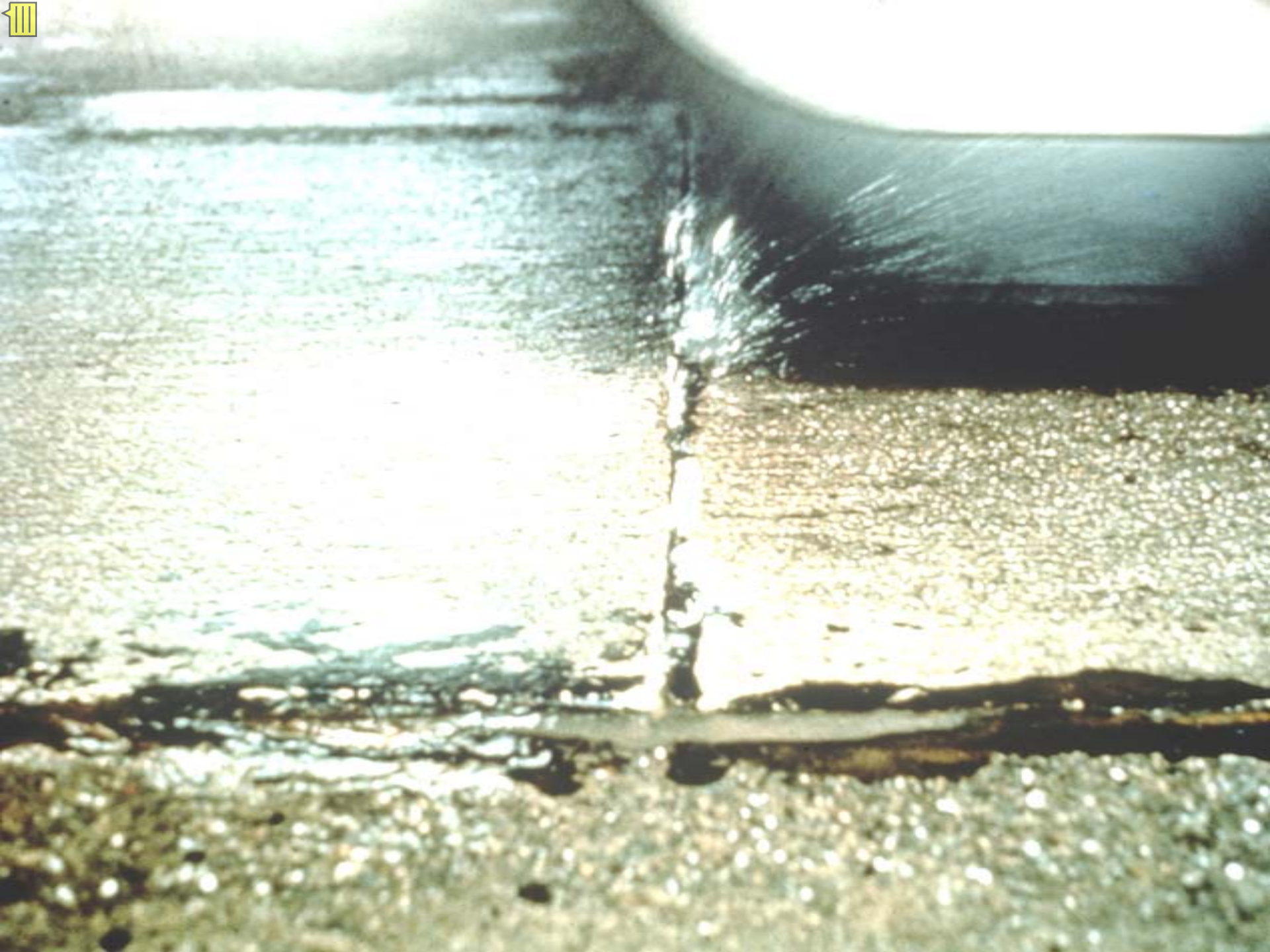




# PCPS Design Considerations

- Structural capacity
  - Load transfer across joint
  - Thickness to match existing pavement
  - Conventional design for new construction
    - If prestressing used, adjust thickness accordingly
  - Expansion joints (longer segments)
- Performance requirements
  - Cracking
  - Joint faulting\*
  - Smoothness
  - Other

Need for PCPS  
performance data  
collection





# Indicators for Long Life

*Full scale testing in California*



Test results  
show  
no cracks or  
distress

**Falling Weight Deflectometer**

**Heavy vehicle simulator**

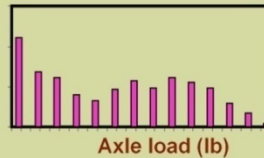
- 140-240 million ESALs
- 25-37 years of traffic
- Grout verifications

# Mechanistic-Empirical Pavement Design Concepts (MEPDG)

## INPUT



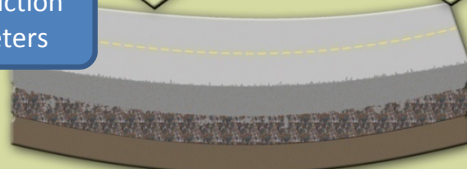
CLIMATE



TRAFFIC



Construction parameters



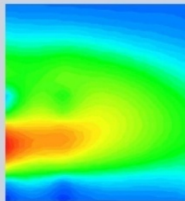
STRUCTURE



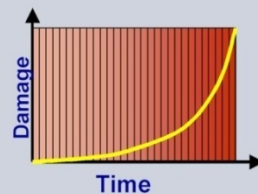
MATERIALS

## PROCESS

Mechanistic Response



Damage Accumulation



Distress Prediction & Reliability

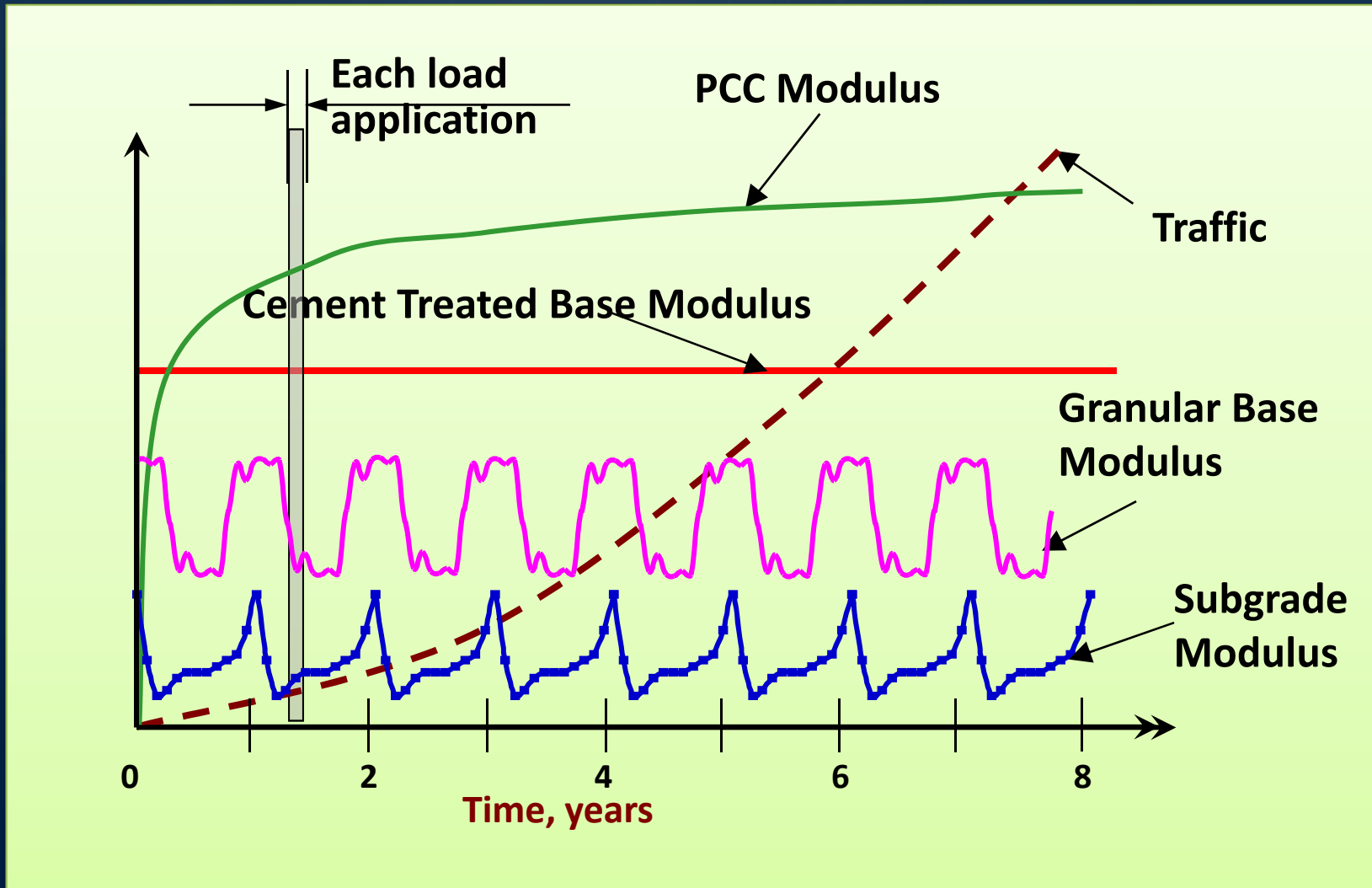


## OUTPUT

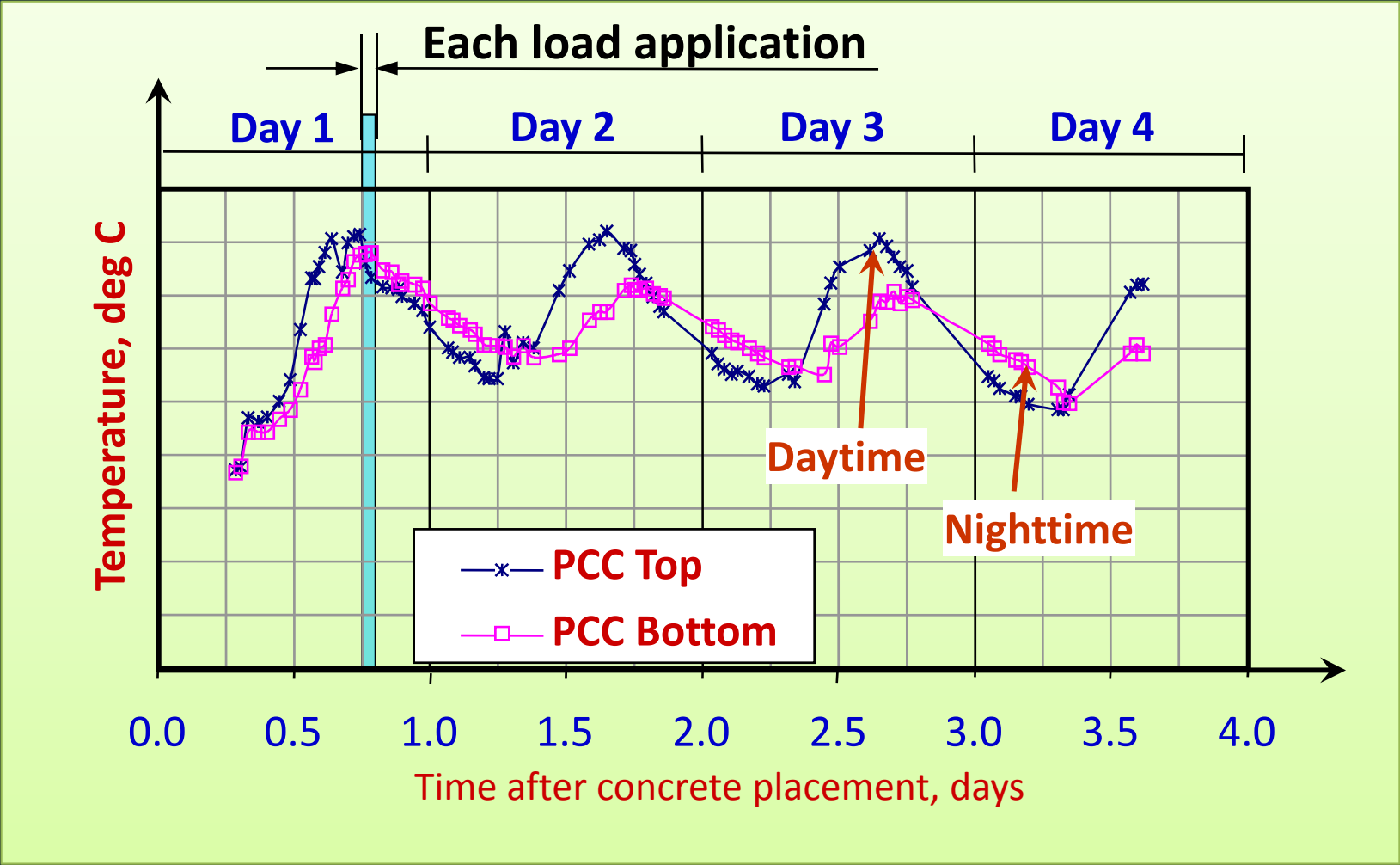


FIELD DISTRESS

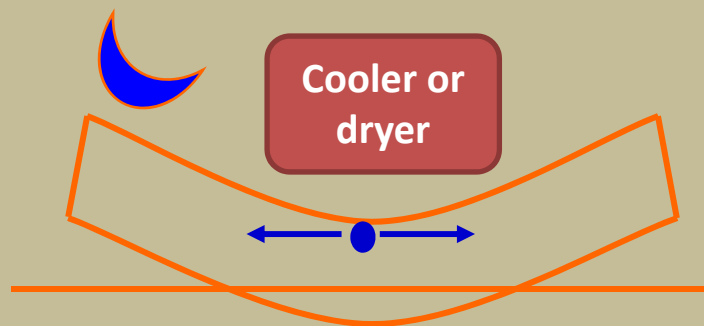
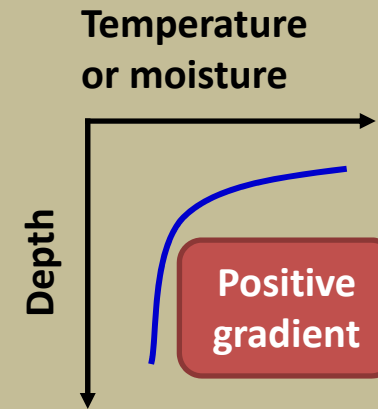
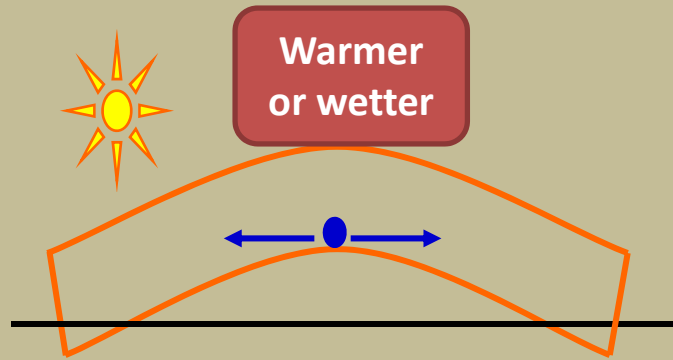
# Concrete Pavement Analyses



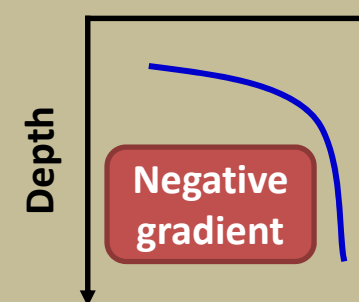
# Daily Temperature Variation



# Slab Curling and Warping



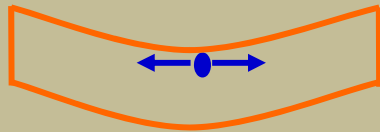
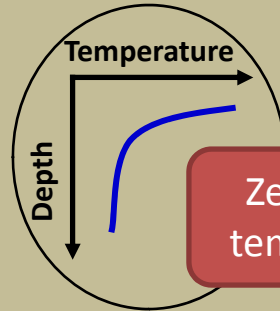
Negative gradient



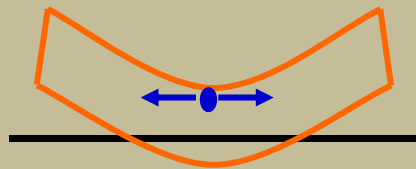
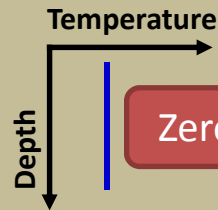
# Construction Gradients in PCC Slab



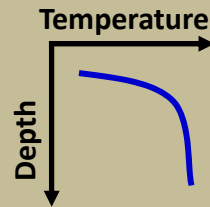
Positive gradient – Flat slab at construction



Zero gradient – Corner curl up



c. Negative gradient – Increased Corner curl up



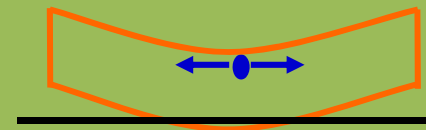
## Precast pavements



Cast off-site in controlled conditions



Almost zero gradient built-in



Negative gradient – minimal corner curl

# PCPS Design Considerations, Cont.

- Smoothness
  - Prefabrication process (tolerances)
  - Grinding if necessary
- Safe (Friction and slope requirements)
  - Prefabrication process
- Economical
  - Total life cycle cost (not just initial cost)

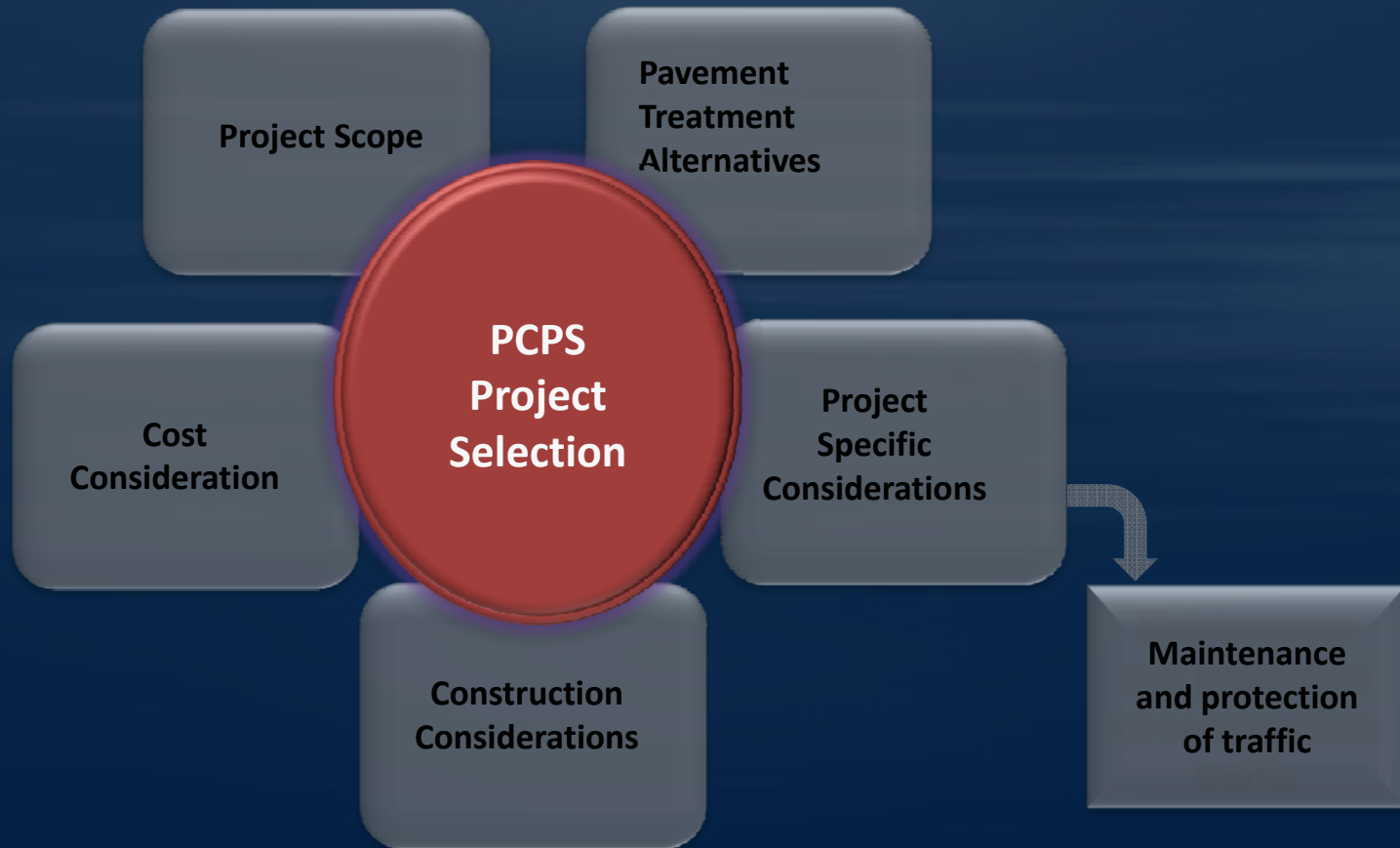
# Design Summary

## Precast vs. Cast-in-Place

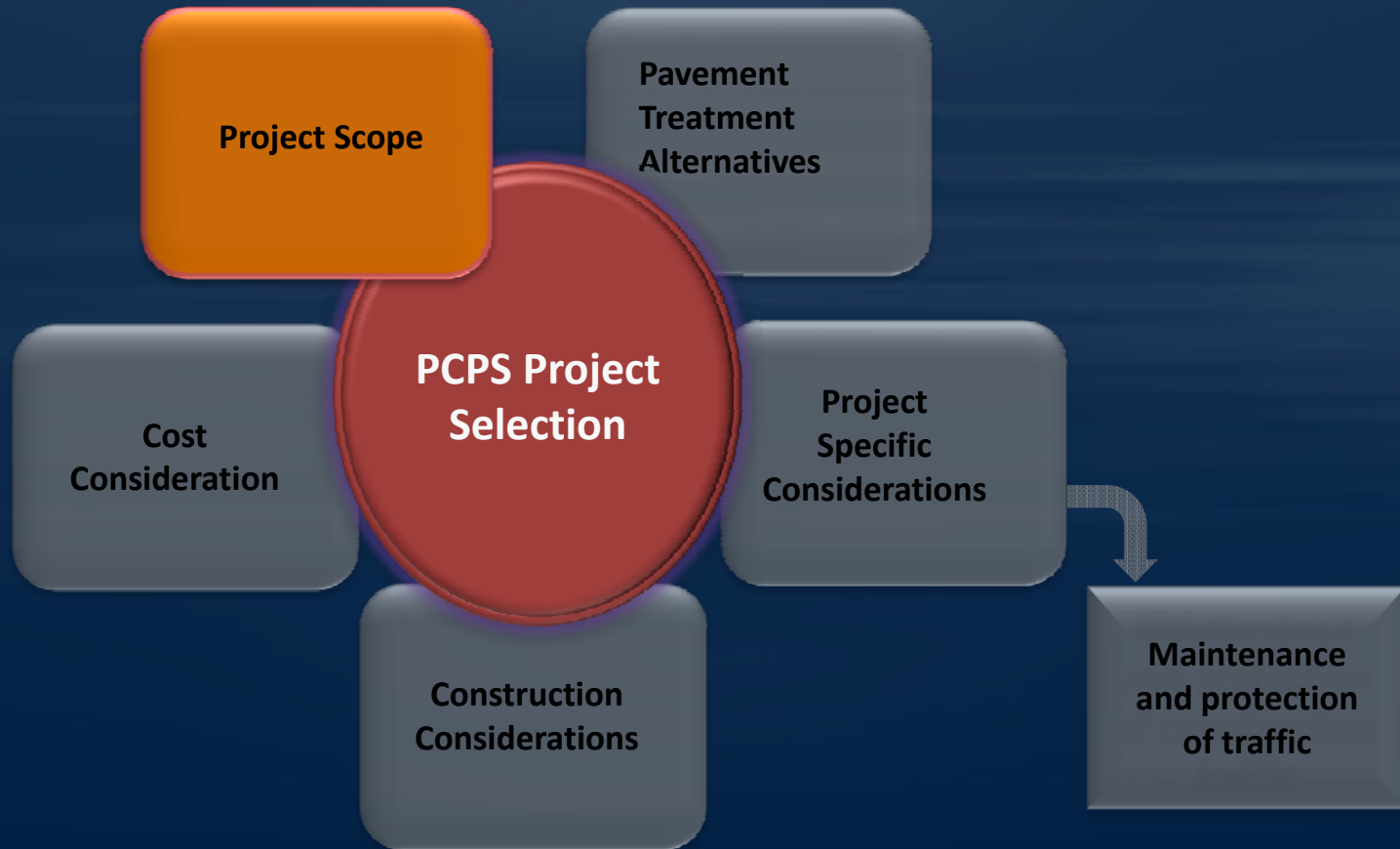
- Design of precast and cast-in-place concrete pavement are the same
- Precast pavement design issues:
  - Base material
  - Different consideration of curling and warping\*
  - Load transfer mechanism\*
  - Expansion joints\*
  - Prestress options\*
  - Smoothness



# Project Level Decision Logic or PCPS Selection Criteria



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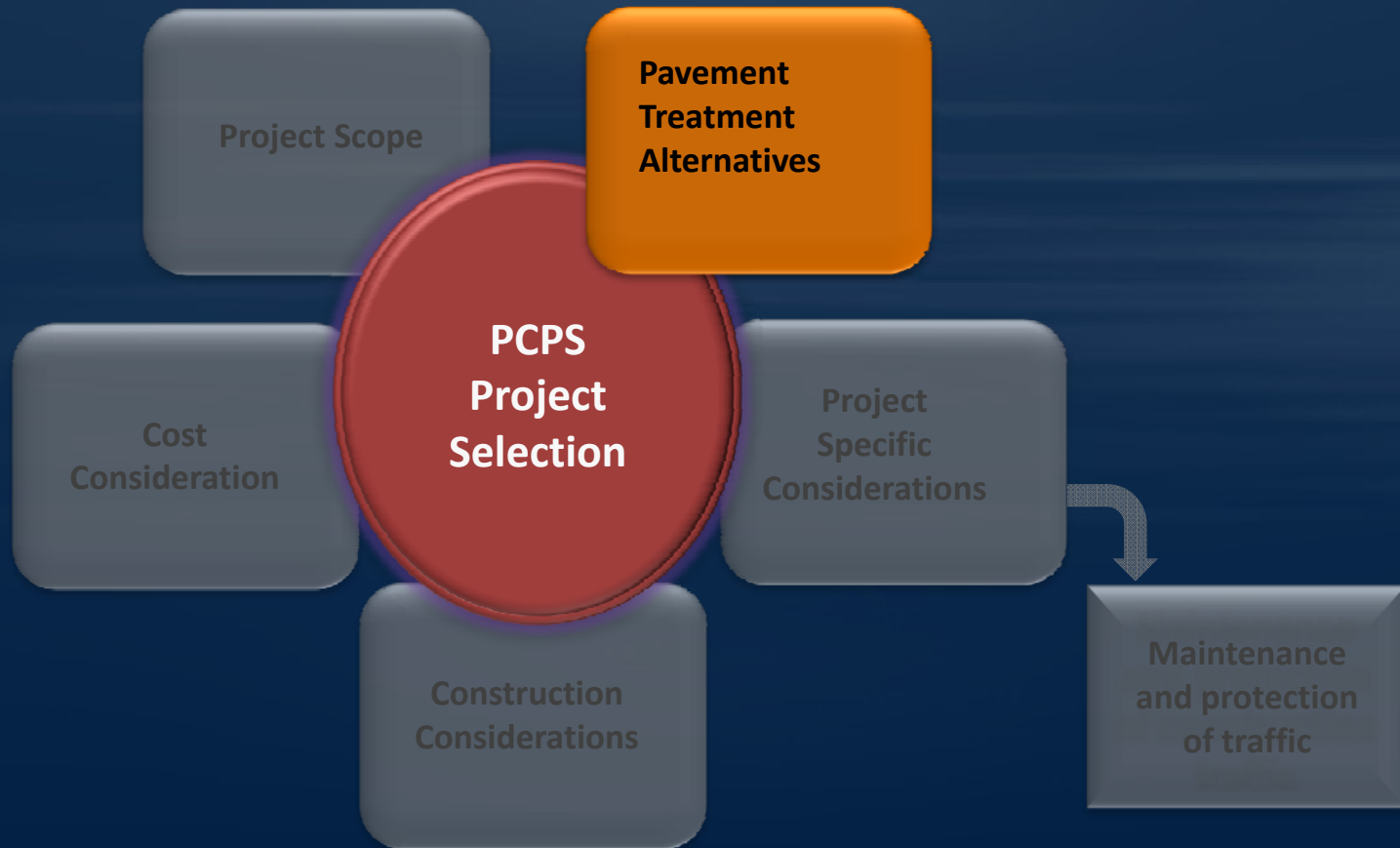




# Project Scope

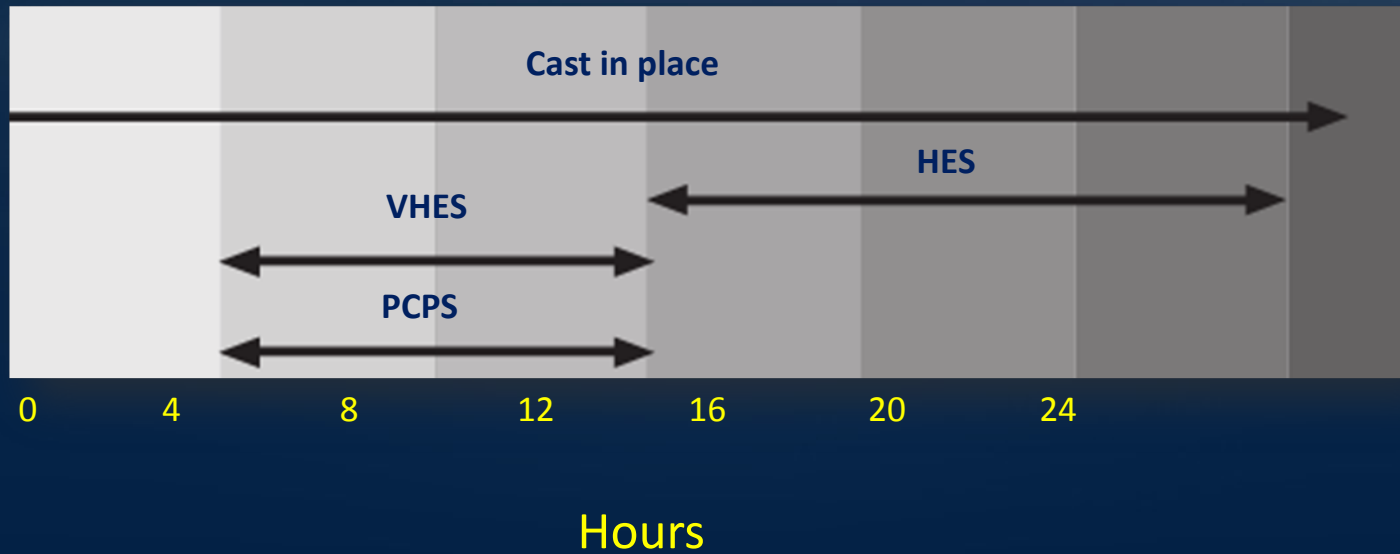
- Pavement service life and objectives
- Current & projected traffic density
- Slab replacement criteria
- Estimated project duration
- Work window options

# Project Level Decision Logic or PCPS Selection Criteria

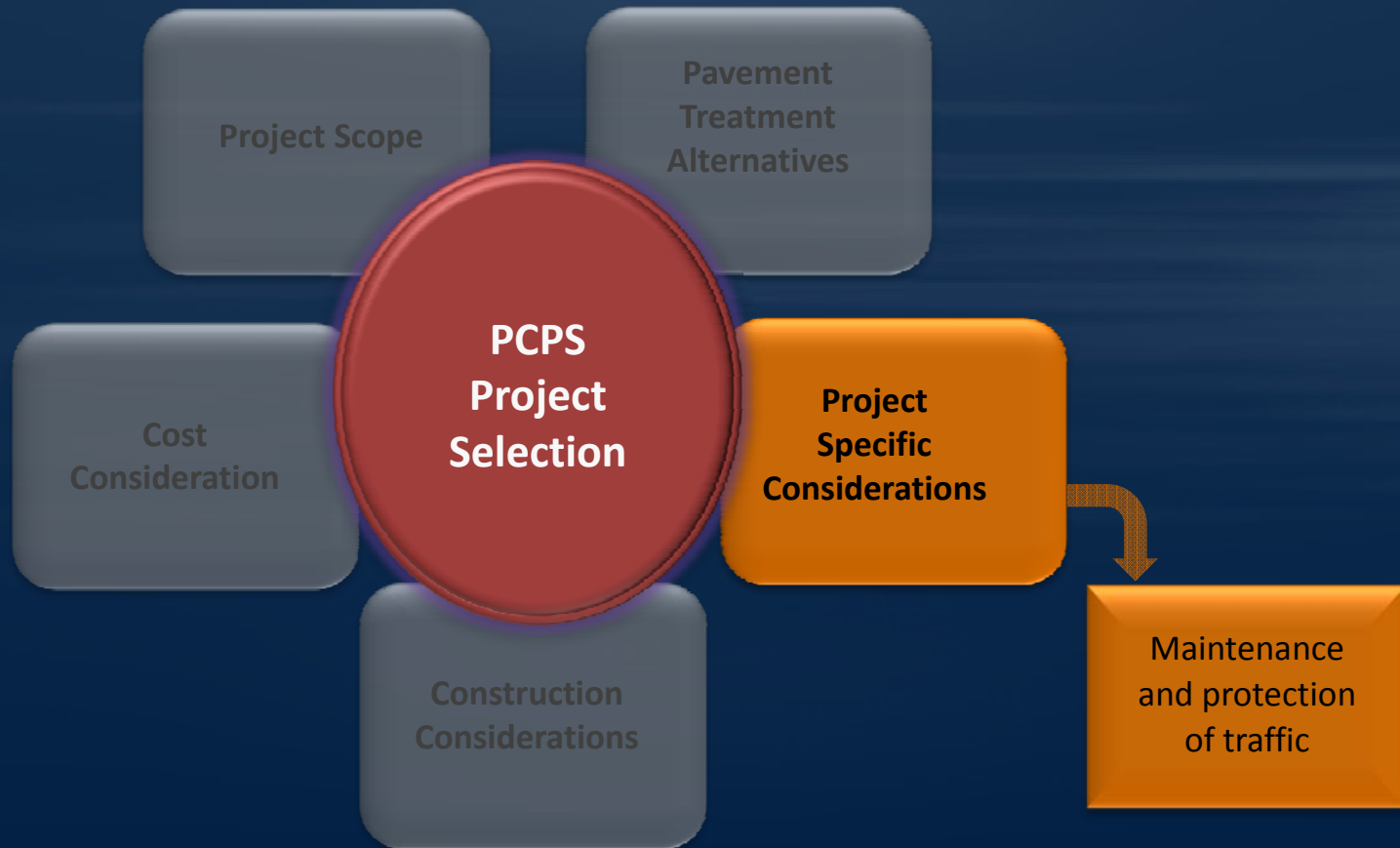


# Pavement Treatment Alternatives

General rules of thumb, based on lane occupancy times




# Project Level Decision Logic or PCPS Selection Criteria





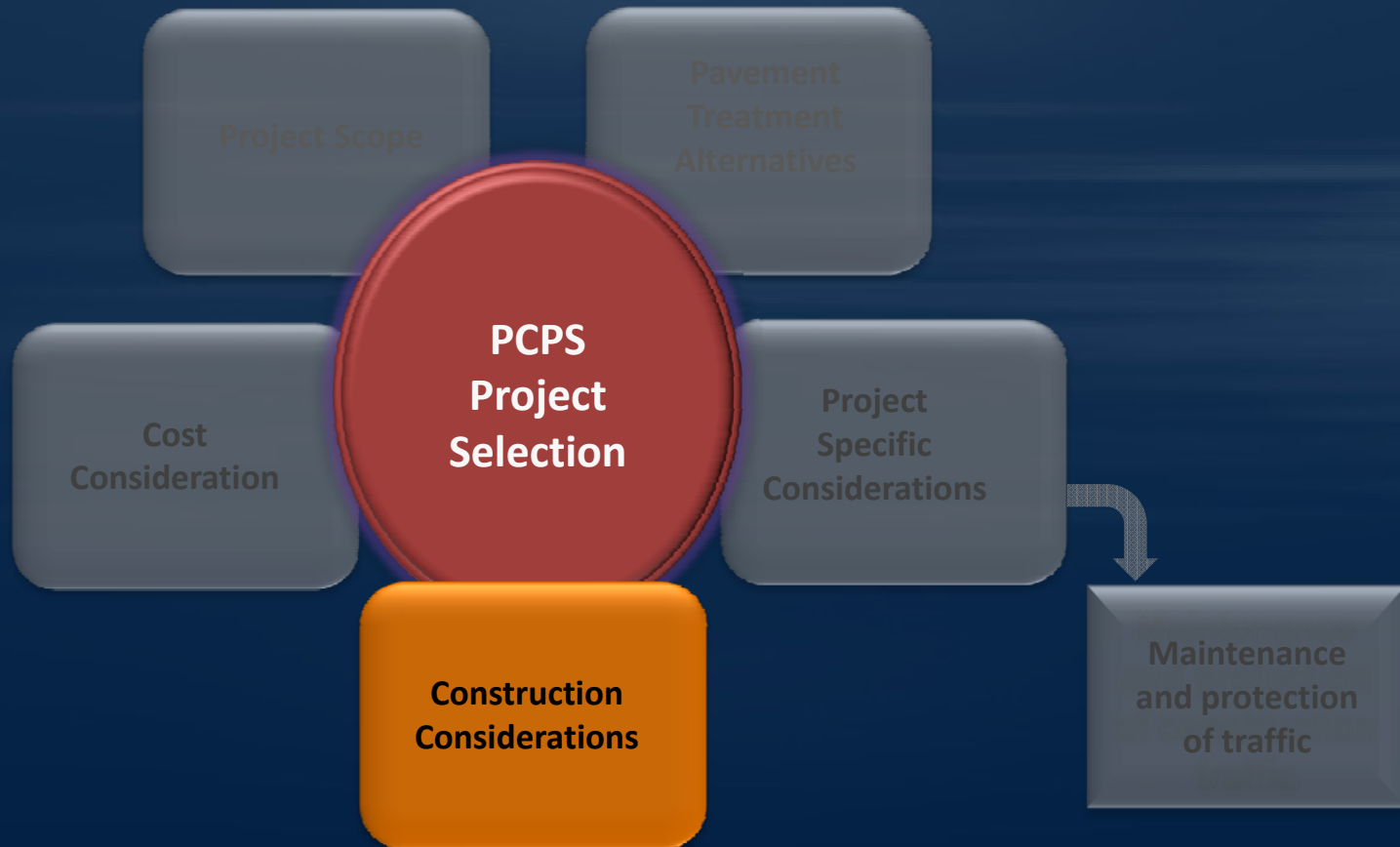
# Project Specific Considerations



Maintenance  
and protection  
of traffic

- Need for accelerated construction
  - M&PT considerations, seasonal restrictions, stakeholder impact
- Funding guidelines
- Design and engineering data requirements
- Construction risk
- Specifications
- Prequalification

# Project Level Decision Logic or PCPS Selection Criteria



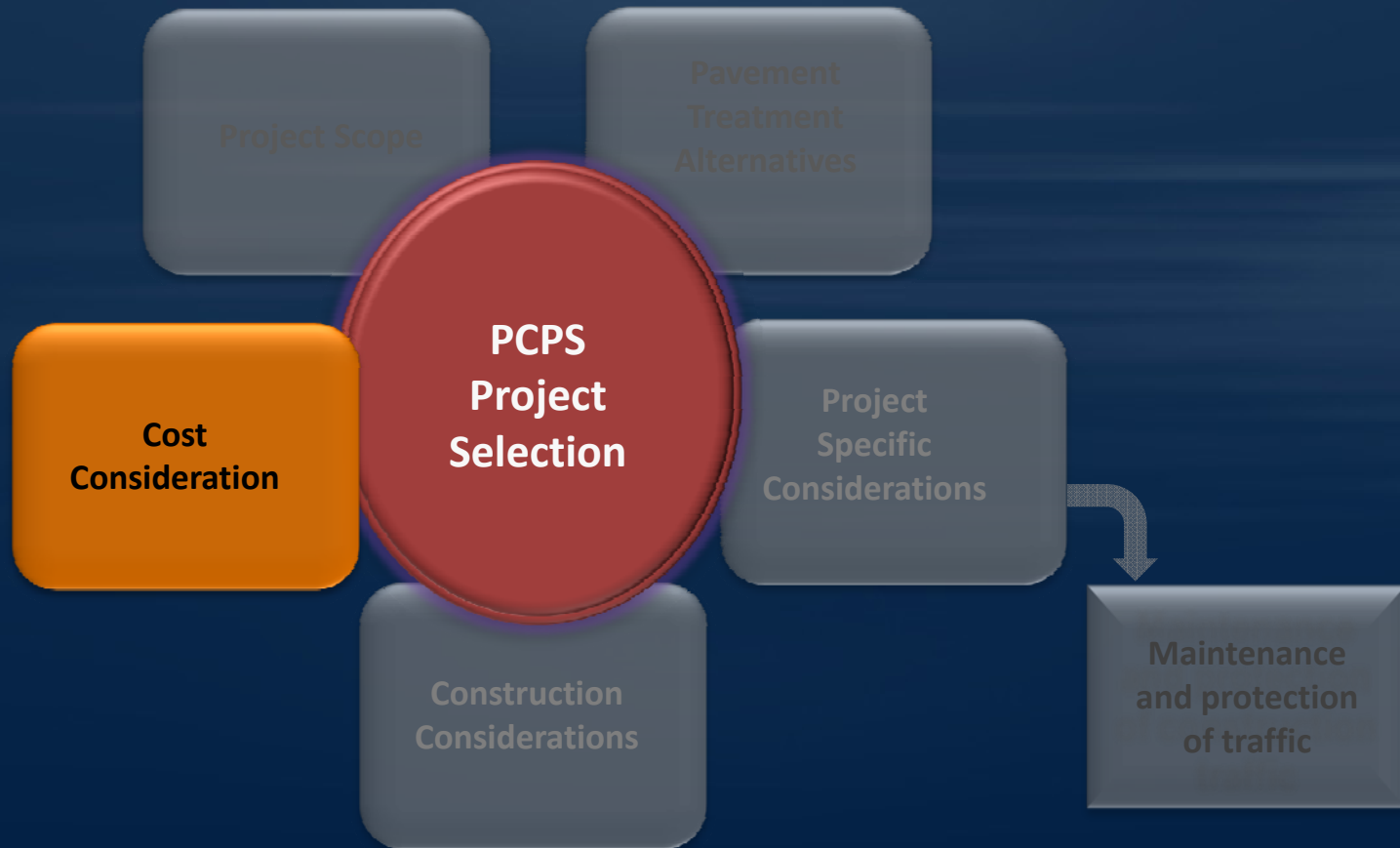




## Construction Considerations

- Qualified precaster presence in area
- Contractor's familiarity with PCPS construction process
- Planning and scheduling
- Quality assurance
- Contract plans

# Project Level Decision Logic or PCPS Selection Criteria





## Cost Considerations

- Should expand beyond initial costs
- LCCA - reduced maintenance costs and user-delay cost
- MTO reports only 10% higher cost than high early strength
- Economies of scale and industry familiarity



# Concluding Remarks

- PCPS is a proven technology
- PCPS is part of a pavement management toolkit
  - Design
  - Construction specifications
  - Performance monitoring
- Life cycle cost analyses provides a realistic estimate of economic benefits

Thank You

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