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CONTEXT SENSITIVE DESIGN

Finding Flexibility in Design Standards



Context Sensitive Design Workshop

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Zan Associates

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In this session:

- Flexibility in Design Standards
- System and Network Relationships
- Design-Safety Relationship
- Tort Liability

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Acknowledgements

- Howard Preston, P.E., Howard R. Green & Associates
- Denny Eyler, P.E., SRF Consulting Group, Inc.
- Fred Dock, P.E., Meyers Mohaddes Associates, Inc.

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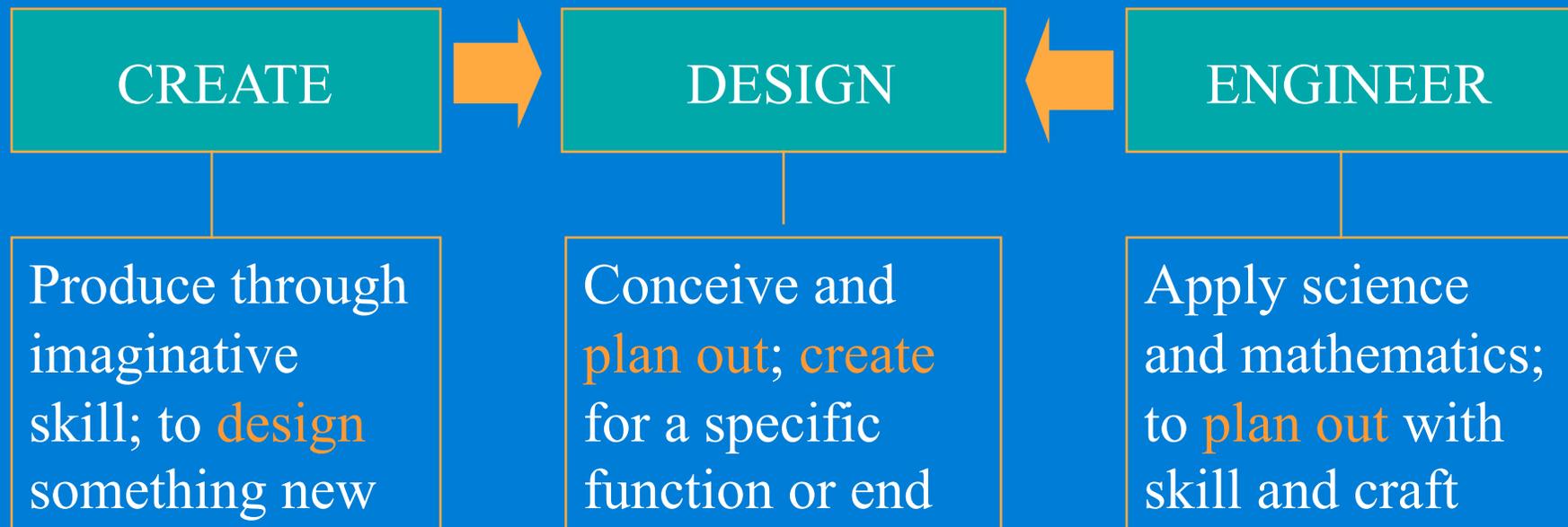
What is Context Sensitive Design?

- “Think Method of Design” – *Howard Preston, P.E.*
- “Doing the Math” – *Denny Eyler, P.E.*
- “Enduring Design” – *Fred Dock, P.E.*

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CSD is firmly rooted in good design

(Values change by minute degrees)



Source: Webster's Dictionary

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Consistent with AASHTO Green Book

“Sufficient flexibility is permitted to encourage independent designs tailored to particular situations.”

“...highway engineers strive to provide for the needs of highway users while maintaining the integrity of the environment.”

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Designer's Challenge:

How do you find the balance point?

Safety
Mobility
Maintenance

Aesthetics
Environmental Issues
Community Goals



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Why Do We have Standards?

- Laws, limits, principles, economics and guidelines lead to **STANDARDS**.
- Makes things more **ORDERLY AND SIMPLE**.
- Makes the **REPETITIVE** part of engineering easier.
- Builds on past **SUCCESSSES**.

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How Did We Get Standards?

- Many developed in the 1930's
- Based on experience and principles
- Standards do vary
- Try to understand their origin
- Assess what is critical and what may in fact be optional

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Do the Math

- Principles reflect the interaction of the road, vehicle and driver.
- Understand the principles, then assess the standards.
- Know the goal, think of the gain versus what is given up, DO THE MATH, seek the variance

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Examples of Principles

- Drivers need 7+ seconds to make complex decisions.
- Reverse curves should be connected with a tangent.
- Headways should be 2+ seconds.
- Stopping sight distance

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Vehicle Characteristics



- Width and Length
- Position of Driver
- Turning Capability
- Braking & Acceleration

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Driver Performance

- Visual Acuity
- Reaction Times
- Decision Making
- Sensory Load
- Attention Span
- Expectations



Performance of Other Modes



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Revelations

- The worst grade separation is safer and operates better than the best intersection
- Slower speeds allow more flexibility
- Single file traffic can be manipulated more easily than multi-lane flow
- Many, many others

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Opportunities for Flexibility

- Network
- Alignment
- Roadway Cross Section
- Intersections and interchanges

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Design Speed Controls

- DESIGN SPEED TABLE

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Example: T.H. 61 (North Shore)



Original Roadway Alignment

Original road alignment under parking lot

State park

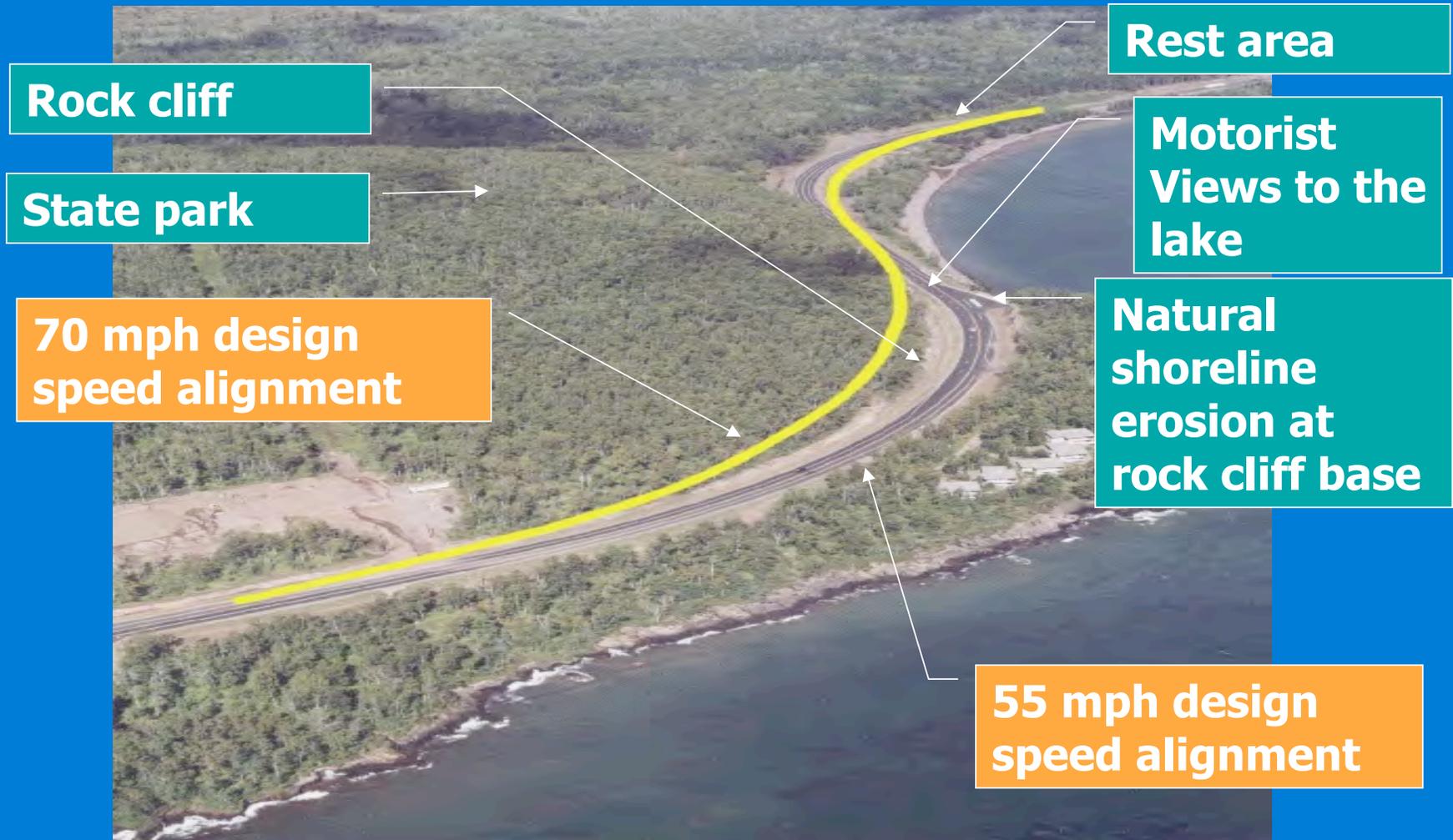
Cutface Creek Rest Area

Shoreline erosion

Cutface Creek bank erosion



Design Flexibility Studies



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New Roadway: 55 mph Design Speed



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Outcome: Design Excellence



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Geometric Design Process

- Always start with and document the recommended values (or theoretical best) for each design feature.
- Identify project goals and objectives.
- Document the consequences of implementing the recommended design values.

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Geometric Design Process (continued)

- Identify the design alternatives, advantages, disadvantages and any safety consequences.
- If there are safety consequences, identify and consider potential mitigation strategies
- Document the entire evaluation process.

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Think, Analyze, Think Again

- Remember that design is ALWAYS a series of trade-offs.
- Don't "cookie cutter" or design by "xerox"
- One size does NOT fill all



Understand the Problems

- Traffic Volumes
- Roadway Geometry
- Intersection Control
- Safety
- Accessibility
- Level of Service
- Mobility/Travel Speed



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Consider All Users

- Autos
- Trucks
- Pedestrians
- Bicycles
- Transit
- Emergency Vehicles
- Commercial Deliveries
- Parking

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Understand Different Points of View

- “This is an arterial highway with some houses alongside.” – *The Engineer*
- “This is a busy street that runs through our neighborhood.” – *The Resident*

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Agree on Goals and Objectives

- All parties agree to context (function vs. setting)
- Each party states what they DESIRE from the project
- Each party understands what they MUST HAVE from the project – or there is no project.

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Enduring Design Goal

- **Concurrency** between function, design, and posted speed
- Road design/operation that reflects land use patterns and vice versa

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Some Common Questions

- How does CSD relate to IRC performance objectives?
- What is a “reasonable” level of capacity?
- What is a “reasonable” level of safety?
- Will CSD create a liability problem?

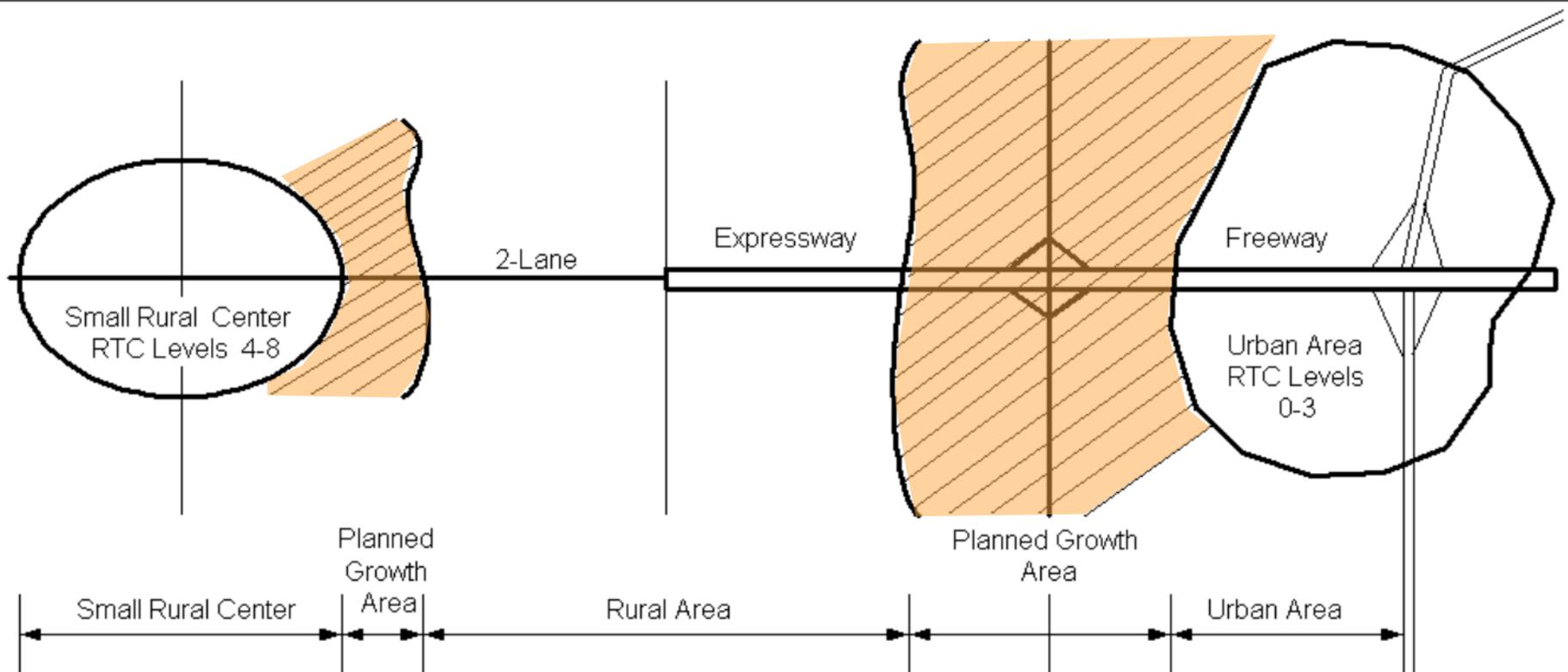
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Question 1:

What about IRC Performance Targets?

| Corridor Type | Corridor Performance | Target Speed (MPH) |
|----------------------|-----------------------------|---------------------------|
| High Priority | Minimum Target | 60 |
| Medium Priority | Minimum Target | 55 |

Understand System Relationships



Mn/DOT

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Know When to Add Network

- Function is highly dependent upon the **proximity** and **density** of other lower and higher order streets in the network.
- Isolated arterials assume local functions because no alternatives exist for access to adjacent property.

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Recognize Change

- Land use, traffic and mode use relationships are dynamic and change over time.
- Enduring design accommodates change and recognizes multi-function aspect of roadways.

Transitions/Gateways

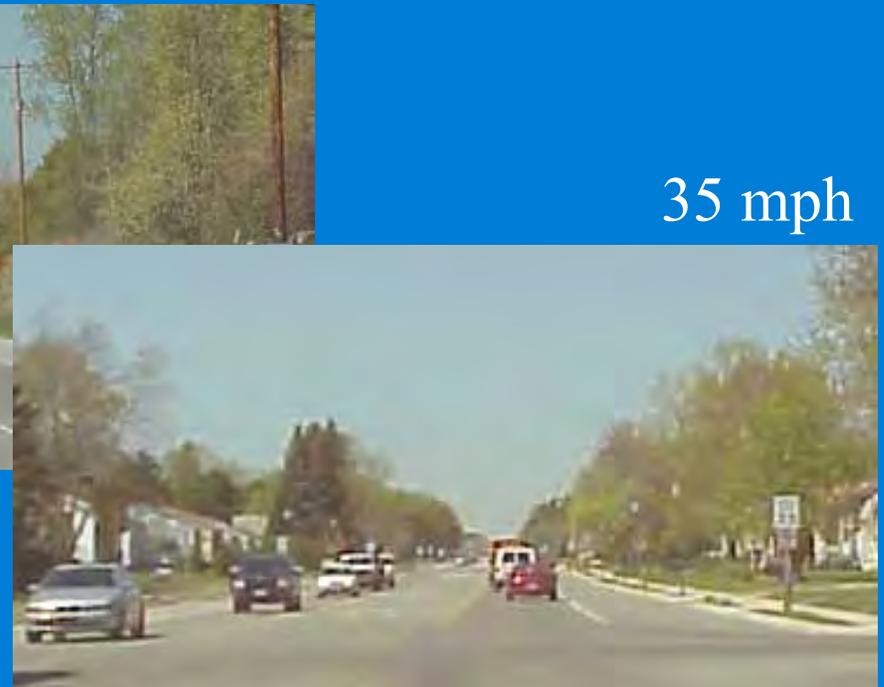
- Edge treatment changes perception of roadway



55 mph



50 mph



35 mph

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Question 2:

What is a Reasonable Level of Capacity?

- With current funding levels, we typically design for LOS “D” in urban areas.
- The capacity of the network is determined by the intersections. If our goal was safety at all costs, we would not have ANY at-grade intersections.

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Example of Flexibility: Turn Lanes

Fact:

Left turn lanes on urban arterials reduce rear end and total crashes.

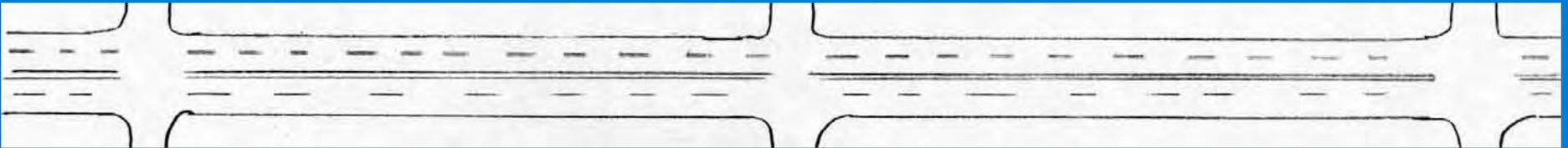
Guidance for turn lane length:

300 feet of full width and 180 feet of taper

Objective :

Provide sufficient length to accommodate deceleration and storage

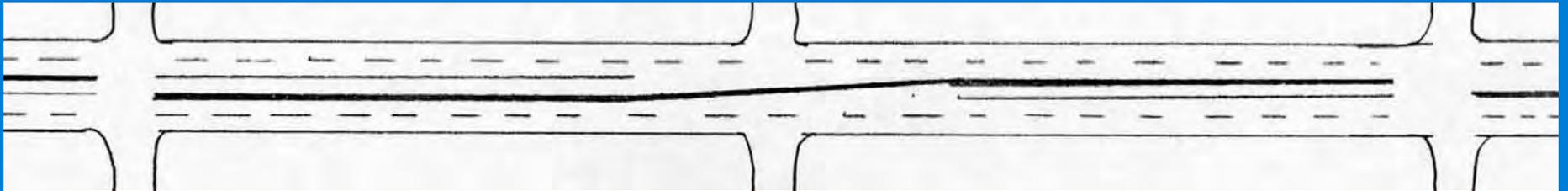
Example: TH 61 in Hastings



Before Condition

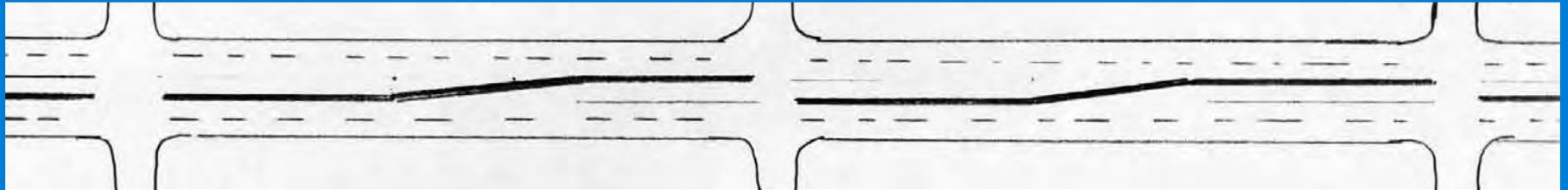
- 4-lane undivided
- High Crash Rate – 13.8 crashes/MVM
- High frequency of rear end (left turn) crashes

Hastings: Alternative 1



- 4-lane Divided / Raised median
- 300 foot Left Turn Lanes & 180 foot Tapers
- Required closing access to every other street
- REJECTED and MnDOT asked to leave town

Hastings: Alternative 2



- 4-lane Divided / Raised median
- 125 foot Left Turn Lanes & 60 foot Tapers
- All public street intersections remained open
- APPROVED and constructed
- Reduced crashes by 44%

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Question 3:

What about Design-Safety Relationship?

- Curvilinear alignments have higher crash rates and run off the road crashes.
- Paved shoulders on rural roads reduce single vehicle and total crash rates.
- Single vehicle crashes are most common type in rural areas.

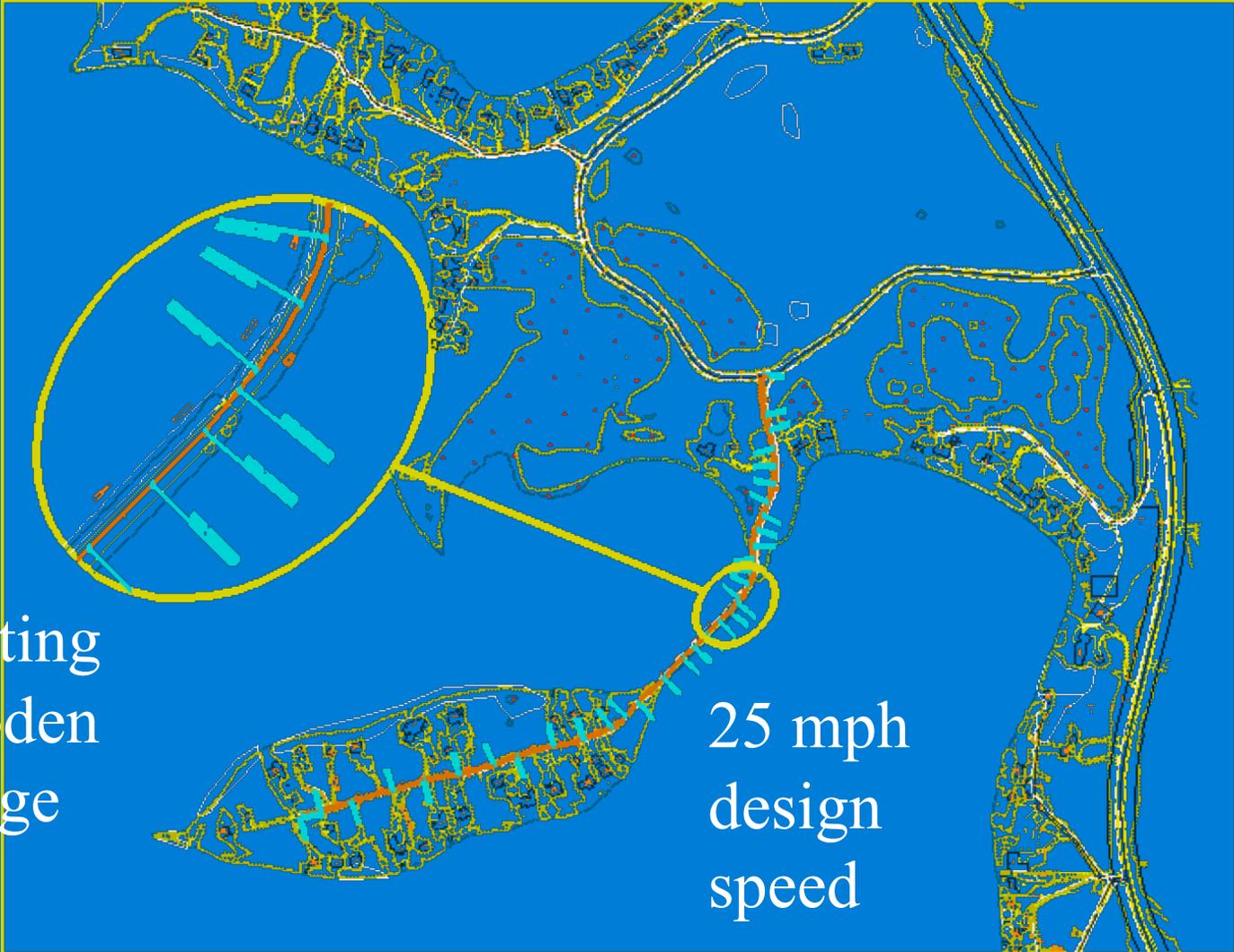
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Evaluate Additional Safety Strategies

- Shoulder rumble strips
- Durable pavement markings
- Delineators
- Street lights
- Signing

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Example: East Gull Lake Bridge



Existing
Wooden
Bridge

The map shows a large body of water with a network of roads and trails. A red line with blue diagonal hatching indicates a 25 mph design speed. A yellow circle highlights a specific section of this road, which is further magnified in a yellow-bordered inset on the left. The inset shows a detailed view of the road's path through the water, with several blue rectangular markers placed along its length. The text 'Existing Wooden Bridge' is positioned to the left of the main map, and '25 mph design speed' is positioned to the right of the highlighted section.

25 mph
design
speed

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East Gull Lake: Project Objectives



- Replace bridge
- Consistent design speed
- Minimize environmental impacts

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Example of Flexibility

Design Guideline: 30-40 mph design speed

Implemented Design:

- 20 mph design
- No fill in the lake
- Warning signs
- Street lights

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Question 4:

Will CSD create a liability problem?

DOCUMENTATION IS

CRITICAL!!

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Tort Liability

- An awareness of liability issues is important.
- Minnesota has a very good tort law.
- Liability does not need to be a significant evaluating criteria.

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Document the Decision Process

- Alternatives
- Evaluating criteria (social, economic, environmental and engineering)
- DECISION

If there is no decision, there is no immunity.

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Safety Issues

- Always consider / document safety issues – what you don't know could be used against you later.
- If you must consider variances from the design guides, document the expected effect on safety and evaluate additional safety strategies.

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In summary:

- Understand the system and network relationships.
- Understand the design-safety relationship.
- Thoroughly document the project development process.
- Be aware but not overly concerned about tort liability.

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Remember:

- CSD is thoroughly rooted in good design.
- CSD is consistent with AASHTO design guidelines.
- Design is *ALWAYS* a series of trade-offs.

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Next Session

- Design Elements
- Pedestrians and bicycles
- Edge treatments
- Aesthetics