Current Trends in Highway Design

Presented by

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Federal Lands Highway

U.S. Department of Transportation
Federal Highway Administration

Columbia, Missouri
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Computer Simulation of
CA 224, Bautista Canyon

Overview of Today's Topics

Monarch Pass, Colorado

Grading with 4-Horse Fresnos

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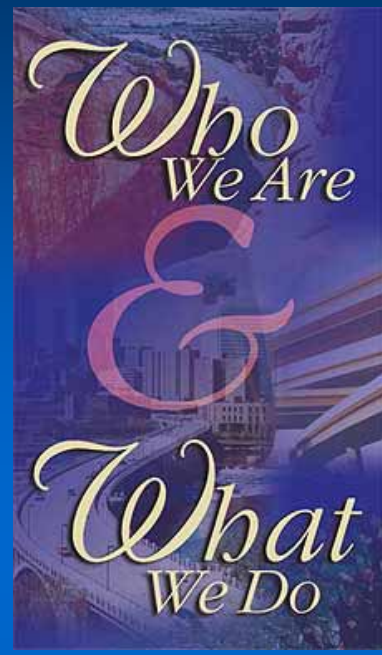
Who is Federal Highway?

- Federal-aid Highway Programs
- Federal Lands Highway Programs
- Our Vital Few Priorities
  - *Safety*
  - *Congestion Mitigation*
  - *Environmental Stewardship and Streamlining*
- 52 Federal-aid Division Offices
- 3 Federal Lands Division Offices
- 4 Resource Center Offices



WWW.FHWA.DOT.GOV

FHWA Field Offices

Why Federal Lands Highway?

- Provide public road access to and within Federal Lands
- Provide engineering and technical services to the Federal land management agencies (FLMAs) and the transportation community
- Implement transportation technology
- Provide training and technical support

Federal Lands Highway Facts

- Federal Lands are 30% of the land in US
- Travel - tourism is the third largest industry in the US and is the largest employer
- There are over 500,000 miles of Federal land management agency roads
- Recreation is growing at a rate of 5% annually
- FLH administers the oldest road program (1914 - Forest Highway Program)

FLH Partners/Customers

- National Park Service
- Forest Service
- Fish and Wildlife Service
- Bureau of Indian Affairs
- Department of Defense

FLH Partners/Customers (cont'd)

- Native American Tribal Governments
- Other Agencies – BLM, BOR, COE
- State DOT's
- Local Governments – D.C., Towns, Counties
- FHWA Division Offices, Resource Center

Types of FLH Projects

- High Volume Urban Parkways
- Rural Parkways in National Parks
- Low Volume Rural Local Roads
- City Streets, Avenues, and Corridors
- Special-purpose Roads
- Scenic Overlooks and Parking Areas
- Pedestrian and Bicycle Facilities
- ATS: Alternative Transportation Systems
- ITS: Intelligent Transportation Systems

FLH's Perspective:

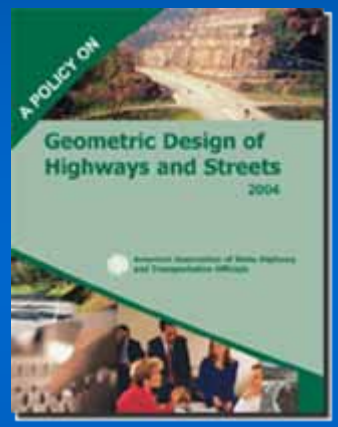
- Long-standing partnerships with FLMA's
  - Sensitivity to FLMA goals and values
  - Collaborative decision-making
  - Use expertise gained from partner agencies
  - Share complementary knowledge & skills
- National Perspective
  - Partner with many agencies and State DOT's
  - Broad geographical coverage
- Able to accommodate other agency standards
- Partners expect delivery of value and quality
- Retain Federal stewardship responsibility

Data and Performance

- Quality data and tools needed for effective engagement of stakeholders and public
- Understanding the basis for design criteria results in a higher level of performance
- Facilities in sensitive environments face higher demands for performance
- Analysis, engineering, and construction all need to be accomplished with ever higher levels of thinking, performance and quality

Performance Oriented Geometric Design Analysis

- Current design practice bases criteria on conditions, not performance
  - Functional Classification
  - ADT
  - Urban/Rural
  - Design Speed



- Compares existing versus recommended
  - Does not quantitatively characterize future performance
  - Does not evaluate the driving task
- Output of analysis is simply dimensions, not performance indicators

Performance Oriented Geometric Design Analysis

- Future trends will be to base design criteria on performance measures
  - Safety performance/consistency
  - Operational performance/reliability
  - Infrastructure performance/sustainability
  - Driver performance/human factors

- Compares predicted versus what is needed
  - Accurate prediction tools to characterize future performance
  - Considers the driving task and experiential values
- Output of analysis is performance indicators to support increasingly difficult decisions

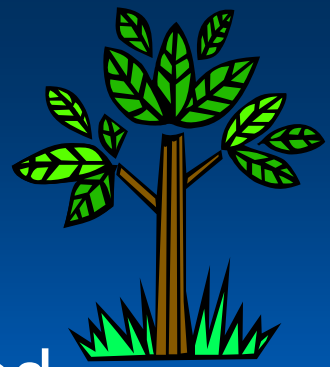
Interactive Highway Safety Design Model (IHSDM)

- Making Safety a Priority in Roadway Design
- Decision-support tool
- Five evaluation modules
  - Crash Prediction
  - Design Consistency
  - Intersection Review
  - Policy Review
  - Traffic Analysis
- Library of the research reports

Interactive Highway Safety Design Model (IHSDM)

- Download free-of-charge from http://www.ihsdm.org
- Quantitative analysis of expected safety and operational performance
- For two-lane rural highways
- Automated for CADD Design
- Compatible with GEOPAK and InRoads

CSS Approach



- Outcome satisfies the purpose and need
- Explores alternatives that equally address goals for safety, mobility, protection of the environment, and reflect community values
- Involves a collaborative, interdisciplinary approach, and effective use of resources
- Involves stakeholders, resource agencies and the public as a part of the design team
- Ensures that outcomes adequately address safety and mobility, and add long term value


Mobility
Safety
Balanced Goals
Preserve Community Values
Enhance the Natural Environment

Why Does FLH Emphasize Context Sensitive Solutions?

- Enables FLH to achieve its vision
- FLH Vision:

  Create the best transportation system ***in balance with*** the values of Federal and Tribal lands

FLH Approach to Delivery

- Facilitate early public involvement, integrated with scoping, to establish purpose and need
- Utilize an interagency, multi-disciplinary team based on identified needs, purpose and scope
- Maintain continuous communication and feedback among partners and stakeholders
- Collaborative decision-making with stakeholders
- Understand the context to guide alternatives which address mobility and safety needs

Recommended Practices

- Verify sound, factual basis for purpose and need
- Be flexible to consider alternative, corridor-specific design criteria that meets the need
- Understand basis for design criteria, and how it affects operational performance and safety risk
- Continuously adjust ever finer, the details that result in a more closer fit to the site conditions
- Follow proven processes that attend to the details affecting quality, across all disciplines
- Draw on lessons the road's history can teach

CSS is Data-intensive

- Greater awareness/understanding of competing goals and values
- Knowledge of both the users' needs and the affected community (context)
- Accurate traffic and crash data to identify safety and mobility needs
- Safety-conscious scoping is emphasized to assure deficiencies are recognized and goals are achieved
- Precise surveys and mapping are needed to best fit local conditions

Leverage the Technology

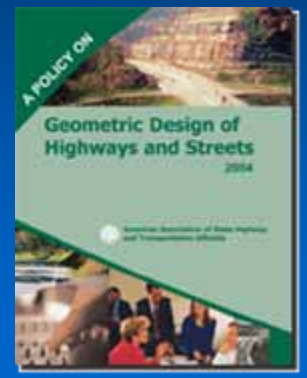
- State-of-the-art interactive highway design and CAD software for quality and productivity
- Continuously upgrade workstations, plotters, servers and network to utilize latest tools
- Maximize integration of geospatial data from all sources (GIS, web, satellite, terrestrial)
- Interchange and share data and design information across all technical disciplines
- Use the survey, mapping, terrain and design modeling from planning through construction

Highway Standards Used by FLH

- Generally…AASHTO Green Book

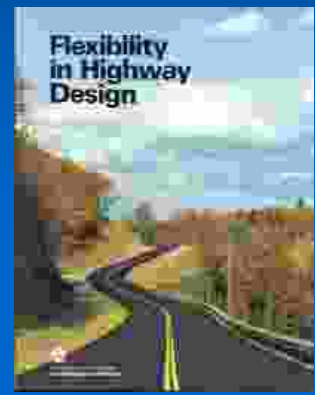
  "Policy on Geometric Design of Highways and Streets"

- Federal Land Agency Standards
- State or Local Design Standards
- Tribal Government Standards



CSS & Road Standards

- Purpose and Function of the Road
  - *- Arterial? - Collector? - Local?*
  - *- Special-Purpose?*
- Level of Traffic
  - *- ADT? -Seasonal? -Design Vehicle?*
- Balance Design Speed & Roadway Width
  - *- With Purpose & Function of Road*
  - *- With Mobility and Safety Needs*
  - *- With Community & Environmental Values*



FLH Design Techniques

- Curvilinear Alignment
  - Lie lightly on the land
  - Follow existing contours
  - Flowing alignment, varying views
  - Coordination of horizontal and vertical
  - Spiral transitions at ends of curves
  - Consistent, self-enforcing design speed
  - Iterative reviews to optimize alignment

Natchez Trace Parkway

Voyageurs National Park, Minnesota

Cherohala Skyway, North Carolina
National Scenic Byway

Roadside Features

- Slope Treatments
  - Rounded Top of Cut and Toe of Fill
  - Warping at Transitions to Cut and Fill
  - Roughening and Compounding
  - Rock Sculpting and Ledging
  - Landscape Planting with Native Species
- Ditches
  - Rounded, Vegetated
  - Masonry Lined (Stone or Brick)
  - Paved with Curbing
- Aesthetic Curbs and Pedestrian Sidewalks
- Fences and Appurtenances which Blend

Rock Sculpturing and Landscaping, Mt. Lemmon, AZ

Mountable Curbs, Baltimore-Washington Parkway, Maryland

Aesthetic Traffic Barriers

- Weathering Steel W-beam
- Etched Galvanized Steel W-beam
- Steel-backed Timber Beam Guardrail
- Steel-backed Timber Log Guardrail
- Simulated Stone Concrete Guardwall
- Natural Stone w/Concrete Core Wall
- Crash Tested and Approved

Skyline Drive, Shenandoah National Park, Virginia

Precast Artificial Stone Guardwall
Baltimore-Washington Parkway, Maryland

Typical Steel-Backed Timber Guardrail, Blue Ridge Parkway

Weathering Steel Guardrail,
George Washington Memorial Parkway, Virginia

Structures that Blend

- Bridges
  - Type, Span, Shape, Formwork, Finishing
- Culverts
  - Shape, Material, End Treatment
- Retaining Walls
  - Aesthetic Facing, Color, Texture
- Natural Materials
  - Accents, Veneers, Facades

Yosemite, California

Stone Masonry Arch, Blue Ridge Parkway

Forehand Hollow Bridge, Natchez Trace Parkway

Double Arch Bridge, Natchez Trace Parkway, Tennessee

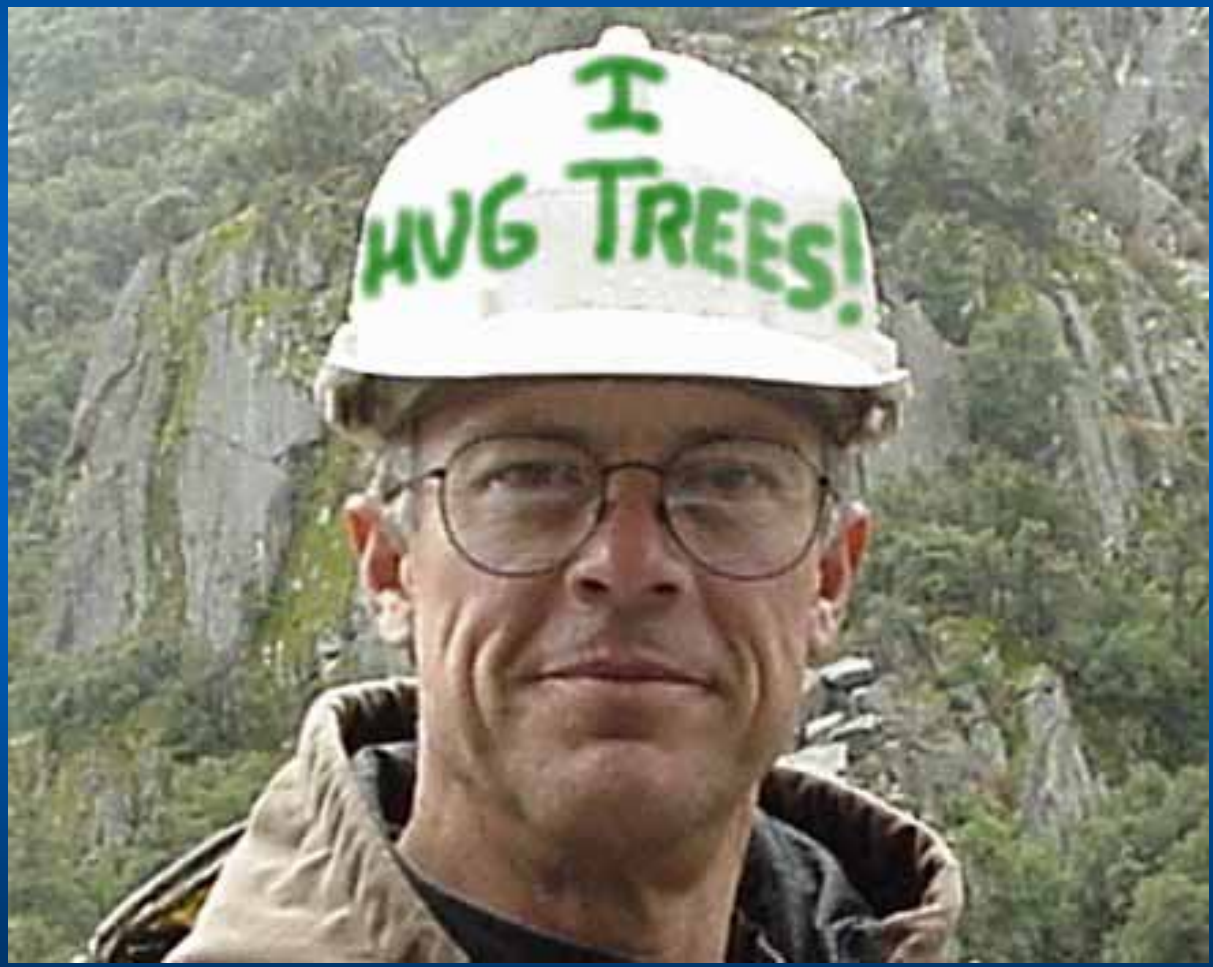
Lake Shore Drive, Lake Mead, NV

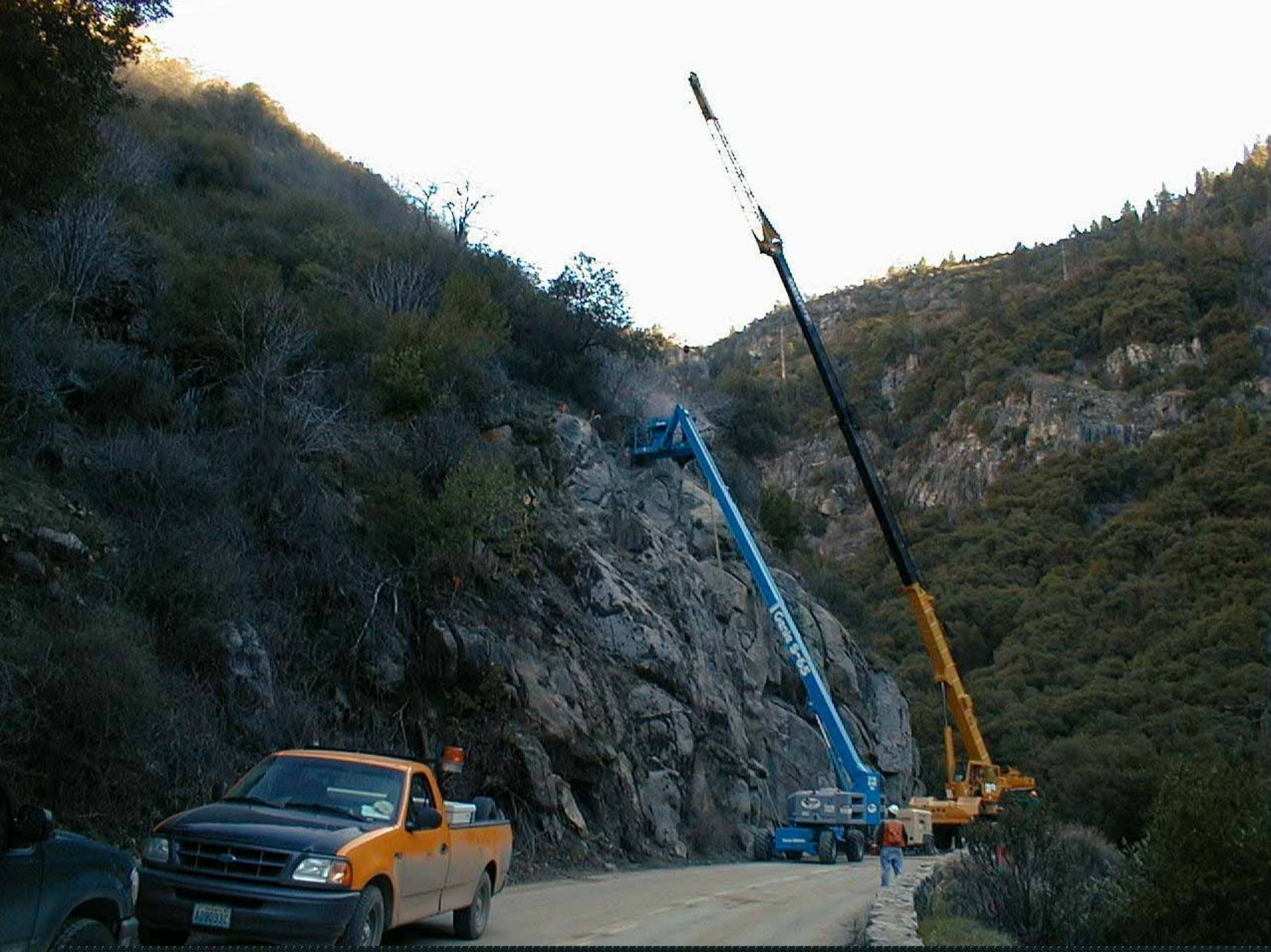
Great Smoky Mountain National Park, Tennessee

Environmental Enhancements

- Adjust roadway location away from critical and sensitive areas
- Restore drainage to original stream channels
- Replace existing culverts with natural bottom culverts for fish passage
- Add crossing structures sized for wildlife
- Restore existing barren slopes with native trees, shrubs and grasses
- Restore hydrology to natural conditions

CSS Construction Techniques

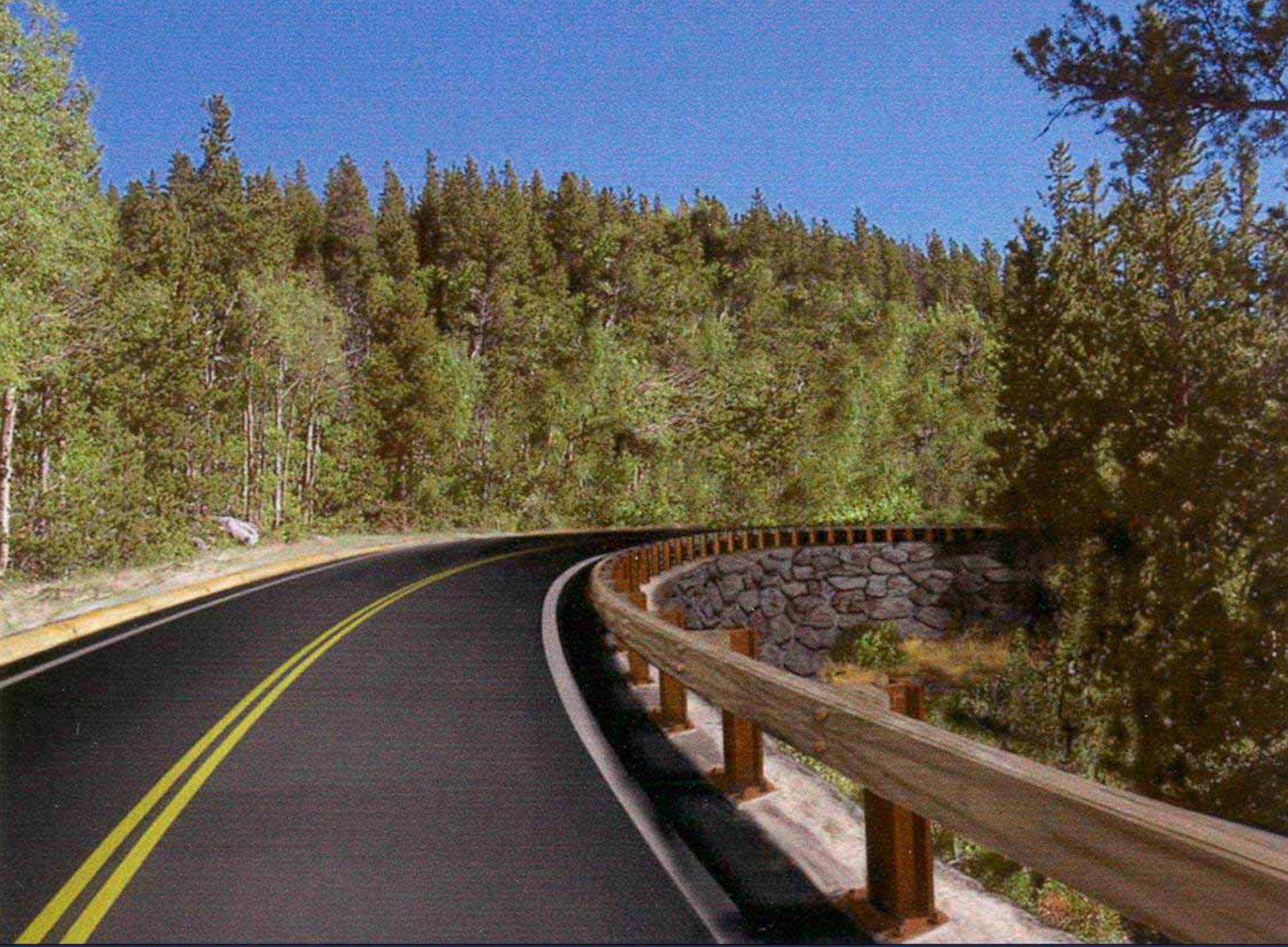




Foothills Parkway, Tennessee


CHARGE

From Planning..... to Reality



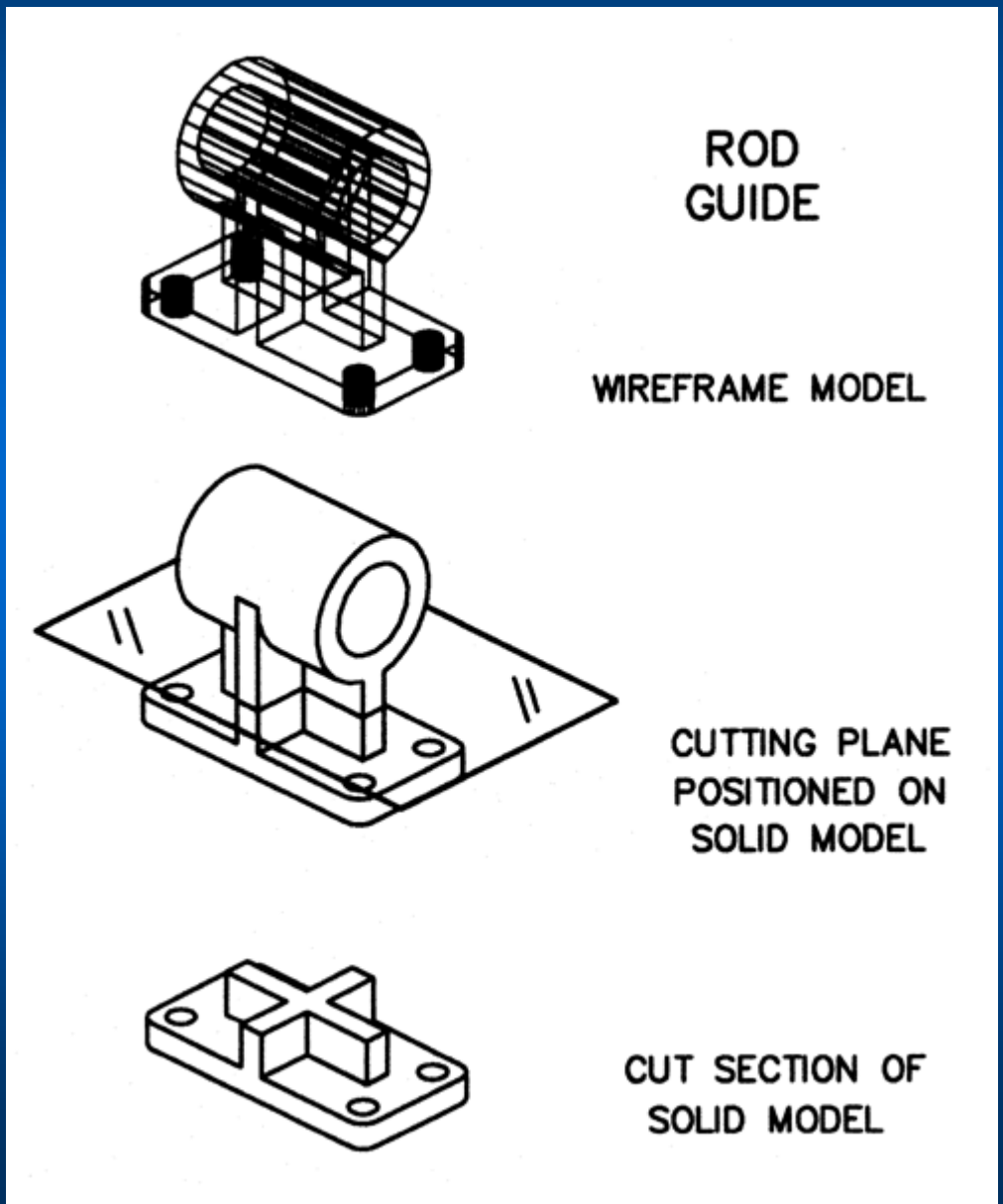
Visualization Applications

- Similar to the State DOTs, primarily 2D photo-simulations for public involvement and Environmental Documents
- For major (high cost/high visibility) projects, 3D models, limited animation, VHS and CD-Rom
- Some use of web-based access
- Limited planning applications (GIS)

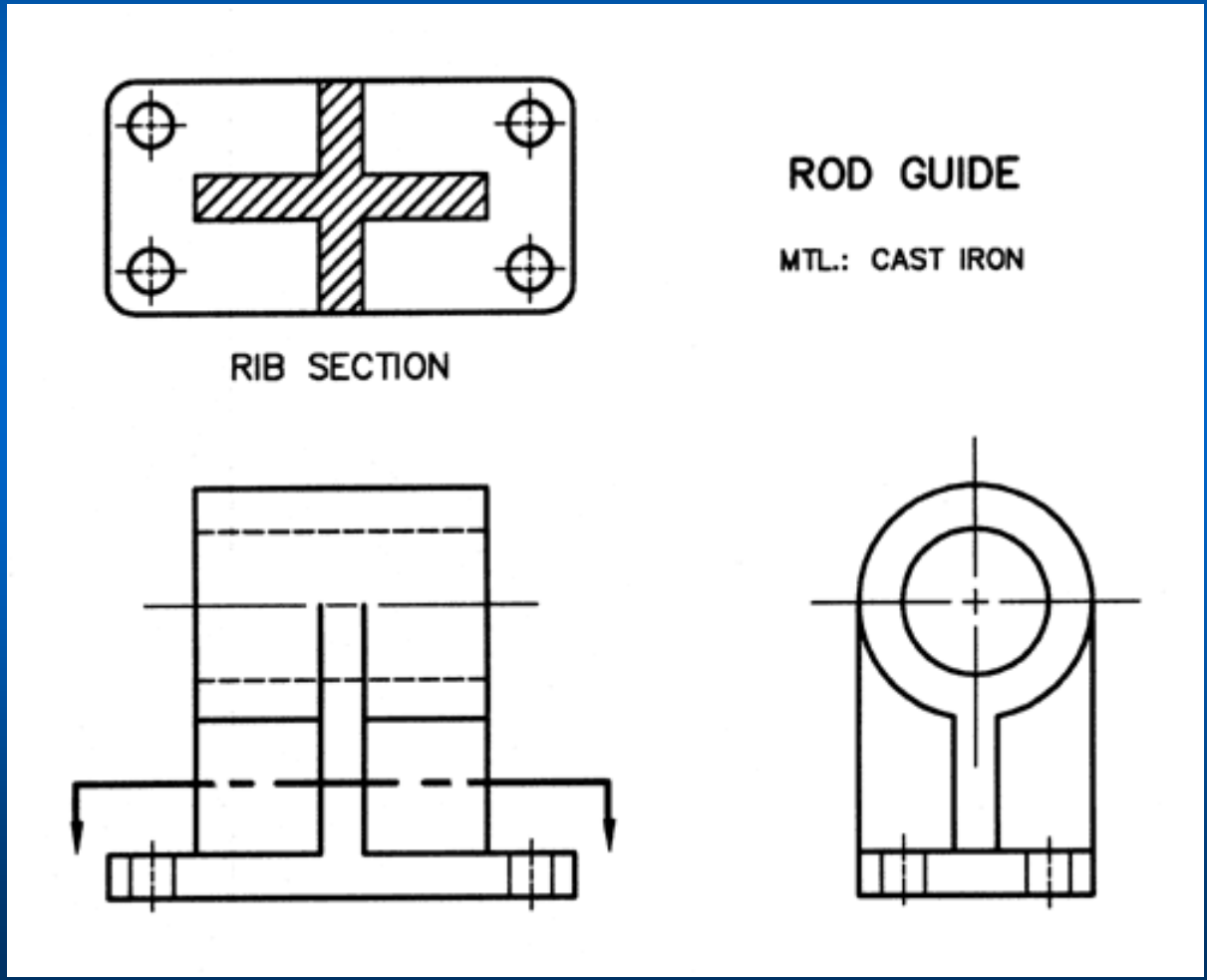
Why Use Visualization?

- Helps Context Sensitive Solutions
- Facilitates Involvement with Stakeholders and the Public
- Promotes Common Understanding
- Simulates the Proposed Facility
  - How it Looks (End Product)
  - How it Operates (Meets Needs)

Engineers Learn to Visualize in 2D



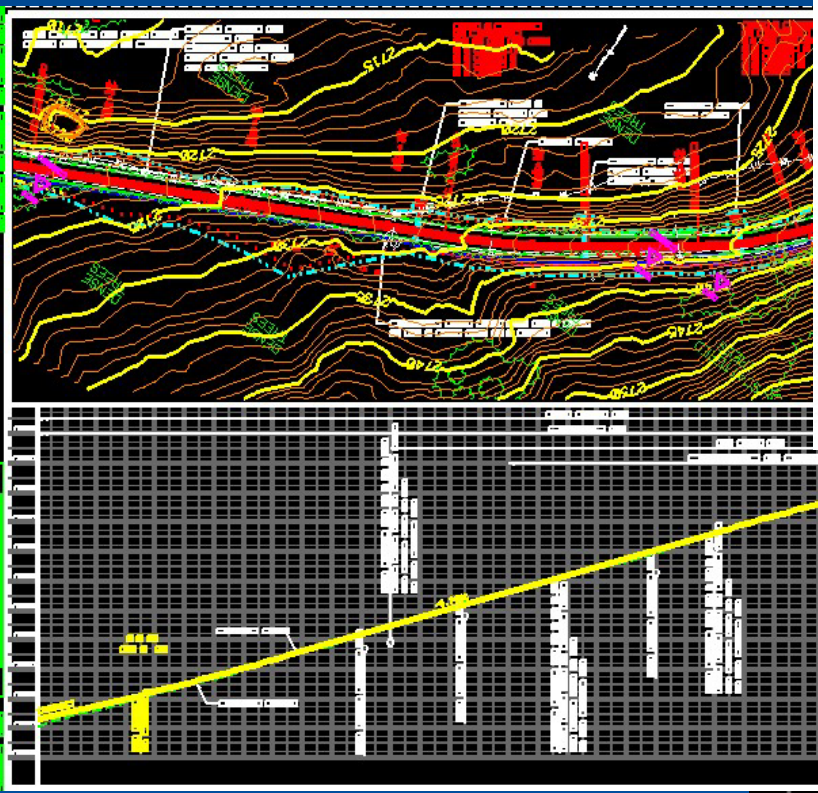
Engineers Learn to Visualize in 2D

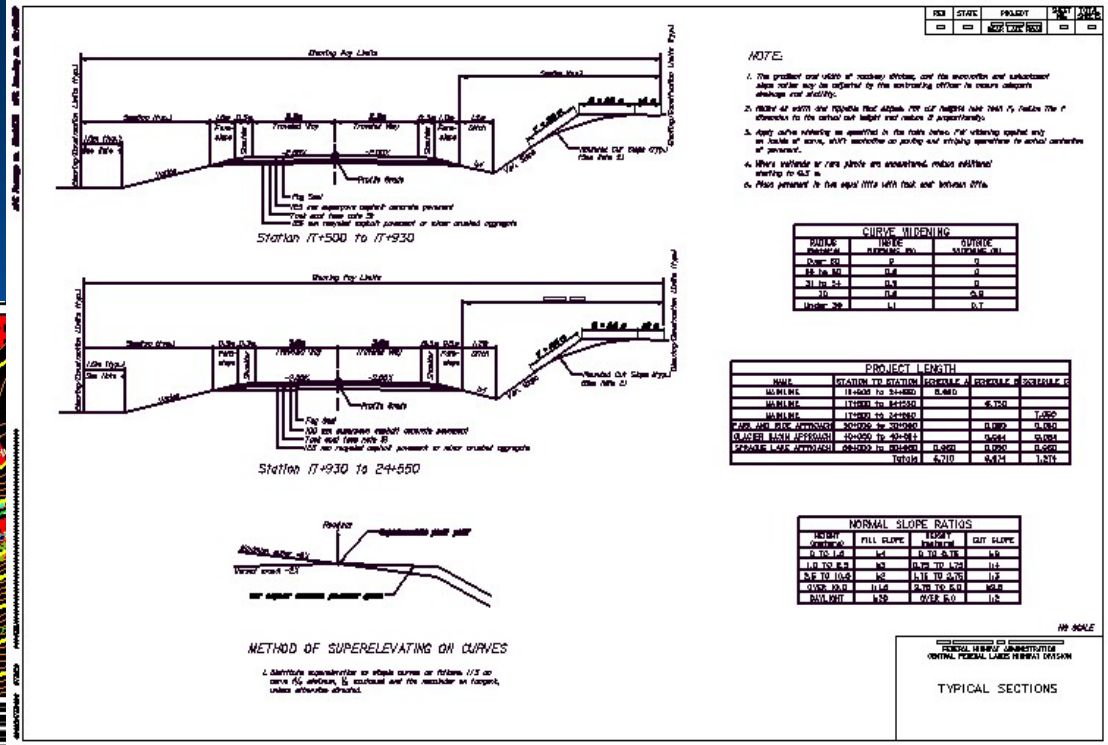


Stakeholders See Differently

- Engineer: Physical Requirements
  “End Product” “Meets Criteria”
- Planner: Needs and Goals
- User: How I Operate On It
- Resident: How It Affects Me
- Community: Sense of Place, Environ. Character, Heritage, Local Values
- Owner: Asset or Liability?

Engineers =




Station 17+500 to 17+930
Station 17+930 to 24+550
METHOD OF SUPERELEVATING ON CURVES
NOTE:
CURVE WIDENING
PROJECT LENGTH
NORMAL SLOPE RATIOS
TYPICAL SECTIONS


0+67.295

Users =

Communication Challenges

- Engineers Speak
  - Green Book
  - Typical Section
  - Pavement Materials
  - Design Speed
  - Crash Rate
  - Constructability
  - Plans and Profiles
  - Cross Sections
- Users Speak
  - Function, Fit
  - Space to Drive
  - Smoothness
  - Comfortable Speed
  - Feels Safe
  - Barricades, Delays
  - TV, Web, Pictures
  - Perspective Views

Form versus Function

- Need to illustrate more than what it will look like, but imply how it will work
- Need to convey contextual value of the project to the user and community
- Need to enable analysis + feedback
- Visualization is only as effective as the understanding and communication it generates for the user or stakeholder

Realism is Necessary – But Not Sufficient

- Conveys Purpose and Need of the Project
  - *Shows what is Important? - User? - Community?*
  - *Safety? - Efficiency? - Environment?*
- Reflects Credibility of Your Work
  - *Is it Accurate? - Understandable? - Add Value?*
- Tailors Information with Audience
  - *Stakeholder: What the facility looks like*
  - *Community: What the facility changes*
  - *User: How well the facility works for me*

Planning & Public Involvement Visualization Applications

- Project Scoping
  - Purpose & Function of Road
  - Describe and Evaluate Alternatives that address needs, issues, and values
- Public Involvement and Communication
- Partner and Stakeholder Participation
- Collaborative Decision-making

Levels of Public Involvement

- Influencing
- Calming
- Informing
- Consulting
- Partnering
- Collaborating
- Citizen Control

What Level Is Requested?

Levels of Interaction

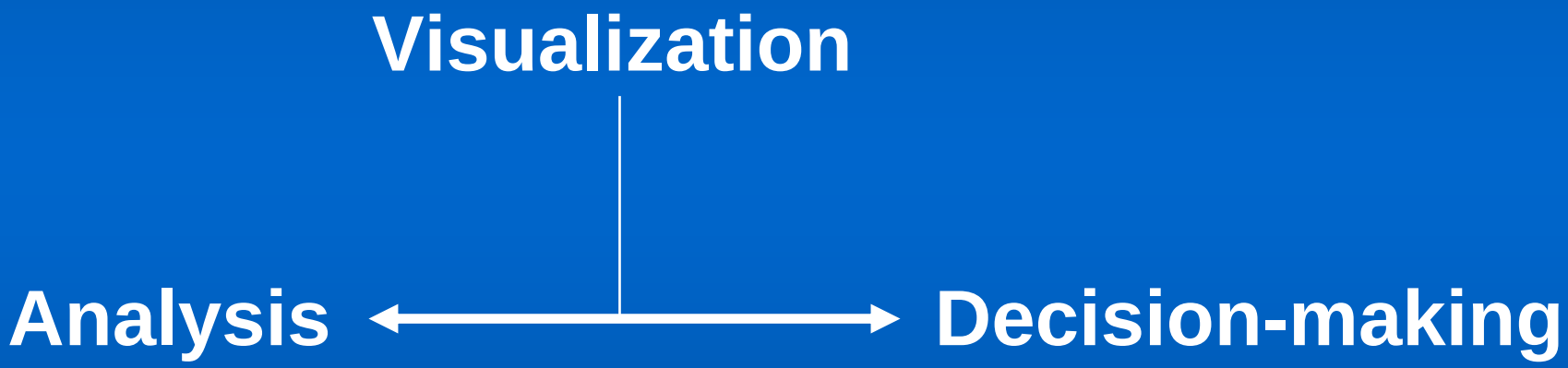
- Imagination – The Engineer's Vision
- Simulation – Show and Tell to Others
- Evaluation – Feedback, Preference, Ranking of Input from Others
- Analysis – Interactive communication, clarification, multi-attribute scoring, consensus-building, collaboration

Levels of Decision-making

- Expert-based
- Stakeholder-based
- Community-based

What Level Is Requested?

Where is Visualization Typically in the Process?



20% - 30% Phase

Visualization Technology

- 3D Perspective Views
  - Intuitive and understandable
  - Capability within GEOPAK software
- 3D Model Navigation
  - Requires a large 3D digital model
  - Enables any custom viewpoint
  - Degrades with close-up view
  - Limited fly-through and navigation capability without special software

Visualization Techniques

- Photo Simulations
  - Shows single location, or aspect of the project
  - Relatively simple, quick and inexpensive
- 360° Views
  - Interactive, provides a context and scale
  - Requires 12 photos, carefully aligned
  - Requires Apple QuickTime Software
- Animation
  - Allows a comprehensive corridor tour
  - Provides a realistic video-like experience
  - Requires a large, rendered, digital “model”

Visualization Products

- Hardcopy Graphics Presentation
  - Exhibit boards and posters
  - Brochures and flyers
  - Graphics and charts
- Electronic Presentation Products
  - Slide Presentations
  - Video CDs and DVDs
  - Interactive CDs
  - Project Web Sites

Example – Guanella Pass

- Diverse Stakeholders and Issues:
  - 2 National Forests & CDOT
  - 3 Owners (2 Counties & Town)
  - National Historic & Mining District
  - Scenic Byway
  - Adjacent to Wilderness Area
  - Private Landowners and Businesses
  - Controversial Corridor Management, Preservation vs. Improved Access

Example – Guanella Pass

Visualization used in the DEIS to show:

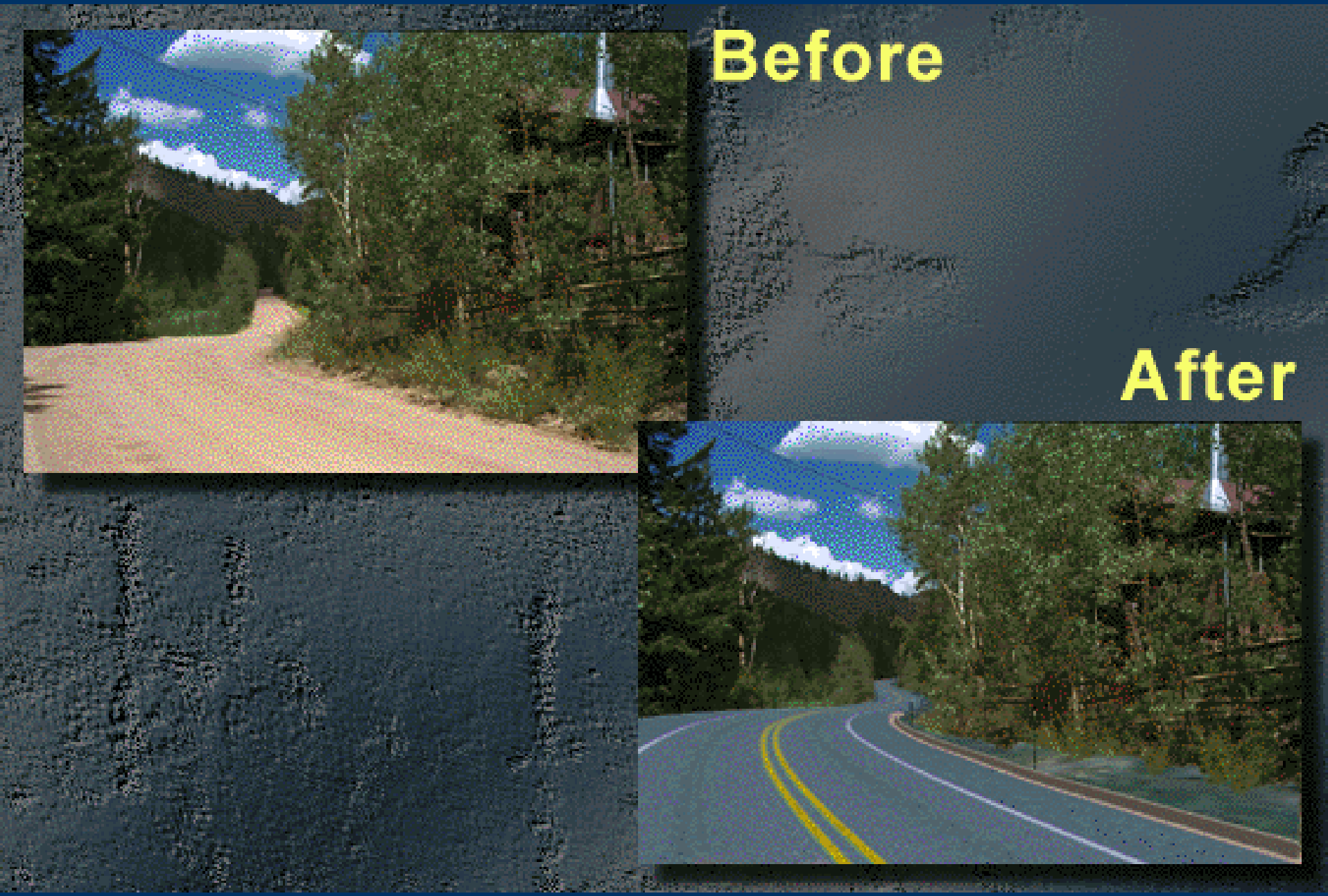
- Mobility Needs
- Safety Needs
- Community Values
- Natural Environment
- Proposed Alternative Design Solutions

Alternatives in DEIS

- Rehabilitate vs. Reconstruct
- Paving vs. Gravel
- Alternative Surface Types
  - Gravel w/Magnesium Chloride
  - Stabilized Gravel w/Admixtures
  - Recycled Asphalt Pavement
  - Macadam (penetration treatment)
  - Pavement w/Coarse Chip Seal

Visualization Applications

- Photo-simulations (before & after) on exhibit boards at public meetings
- Continuous videotape loop played on TV at public meetings
- Interactive CD-Rom included in DEIS document (live video, narration, maps, photo-simulations, 360 views, and animations of alternatives)
- Website with materials from CD-Rom


Before
After

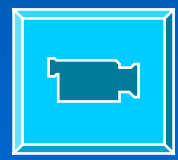

Before
After

Reconstruct w/Gravel

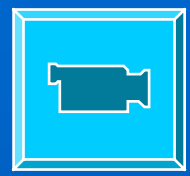
Reconstruct w/Macadam

360 Views (before & after)

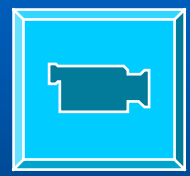
Switchback 360 View Before



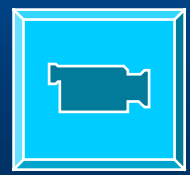
Switchback 360 View After



Georgetown 360 View Before

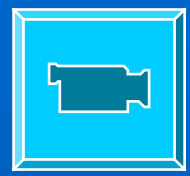


Georgetown 360 View After



Animation Excerpts from CD

Guanella Pass Movie Video Clip



How did Visualization add value?

- Identified true concerns
  - Rustic “backway” vs “parkway”
  - Impact of alternative alignments
- Need for aesthetic treatments
  - Retaining walls
  - Barrier rails
  - Curbs and ditches
- Showed the project could lay lightly

Example – Hoover Dam Bypass

Example – Hoover Dam Bypass (US 93 in AZ & NV)

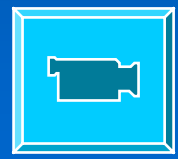
- Diverse Stakeholders and Issues:
  - 2 State DOTs (owners)
  - BuRec, NPS, Hoover Dam, FHWA
  - National Historic Landmark
  - Adjacent Traditional Cultural Property
  - NAFTA Truck Route
  - Security of Hoover Dam
  - Safety, Congestion, Capacity Issues

Visualization Applications

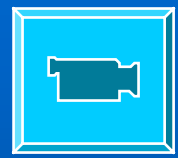
- Photo-montage of alternative corridor alignments
- Photo Simulations (before & after) at public meetings and in EIS
- Interactive Split-screen animation
- Website with photo simulations and fly-through animation

HDB Animation

HDB Split-Screen Video



Building HDB River Bridge



How did Visualization add value?

- Corridor Selection
- Relationship to Hoover Dam
- Scale of Colorado River Bridge vs Hoover Dam
- Bridge Type Selection
- Proximity to Traditional Cultural Property Site

Example – Beartooth Highway

Beartooth Highway

- Diverse Stakeholders and Issues:
  - 3 National Forests
  - 2 State DOTs (WY & MT)
  - Maintained by NPS
  - All-America Scenic Byway
  - Adjacent to Wilderness Area
  - Access to Yellowstone NP
  - Endangered Species, Wetlands, Historic Resources, Alpine Tundra

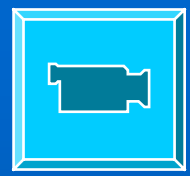
Visualization Applications

- Photo Simulations (before & after) on exhibit boards at public meetings
- Continuous Videotape Loop played on TV/VCR at public meetings
- Interactive CD-Rom included in all DEIS copies (live video narration, maps, photo-simulations, 360 views, and animations of alternatives)
- Website with materials from CD-Rom

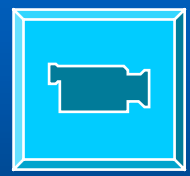
360 Views (before & after)

Beartooth Ravine 360 View Before

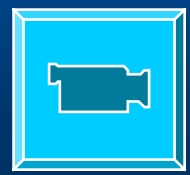
Beartooth Ravine 360 View After



Deadman’s Curve 360 View Before



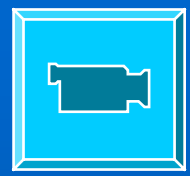
Deadman’s Curve 360 View After



Animation Excerpts from CD

Beartooth Hwy Intro Video Clip

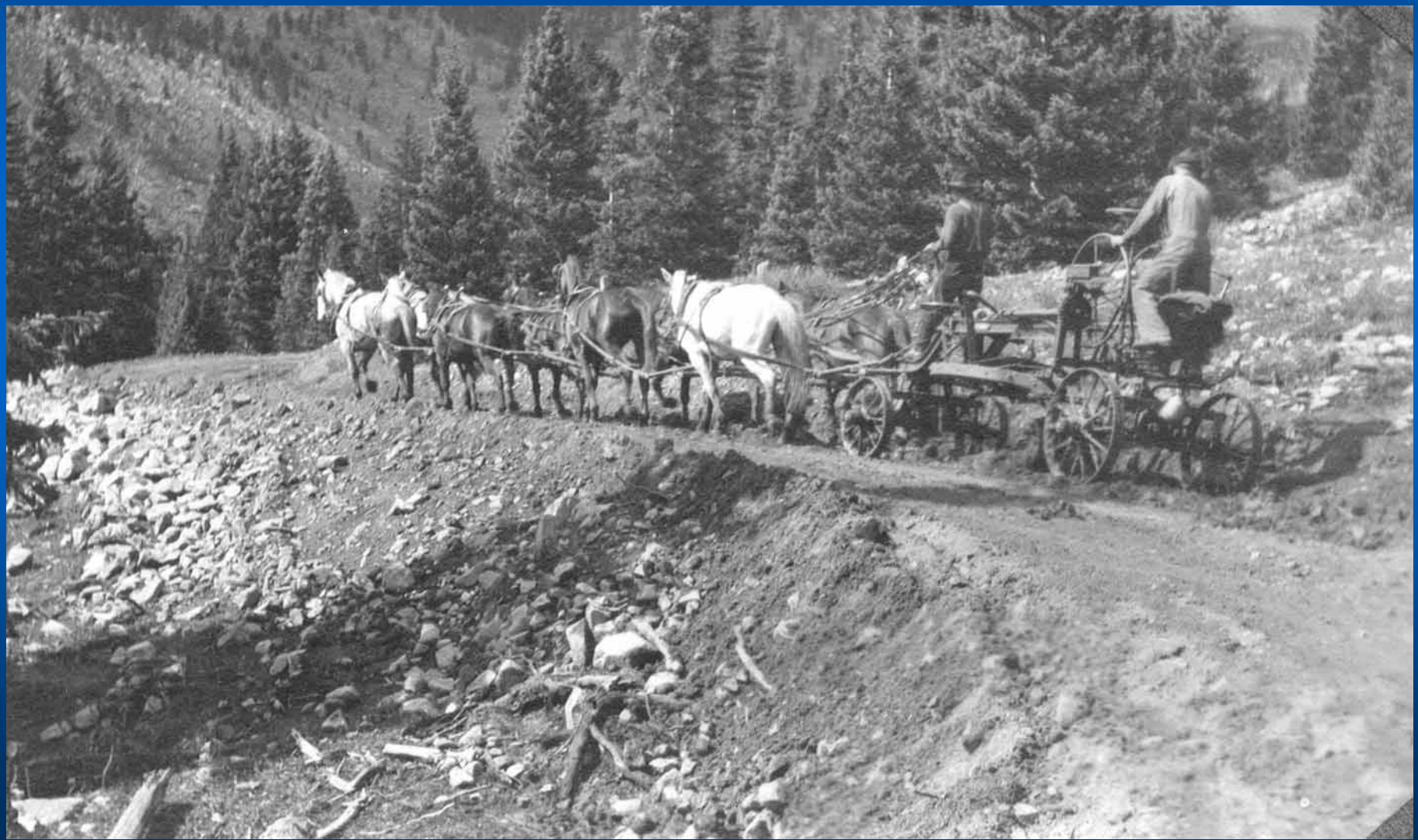
Beartooth Hwy Movie Video Clip



How did Visualization add value?

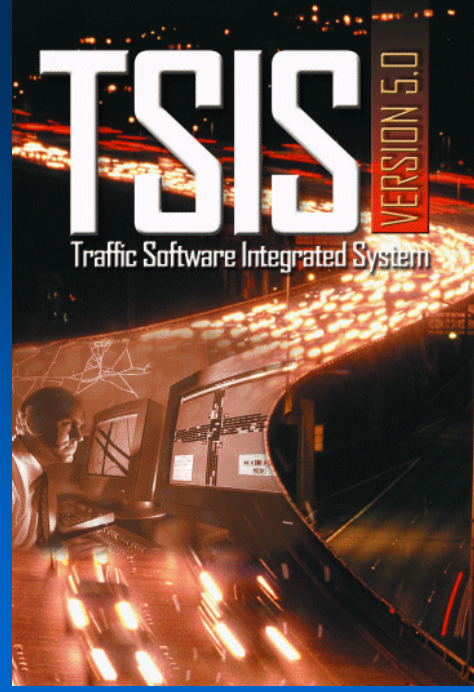
- Help resolve alternative alignment issues
  - Evaluation of new wetland impacts vs restoration opportunities
  - Illustrated pros/cons of alternative alignments vs perpetuation of existing alignment
- Bridge type selection
- Selection of aesthetic treatments
  - Retaining walls
  - Bridge rails design
  - Curbs and ditches
- Design major parking areas and pullouts

Emerging Technologies:



Traffic Operations

- Traffic Simulation Software
  - CORSIM
  - VISSIM
- Visualization Application

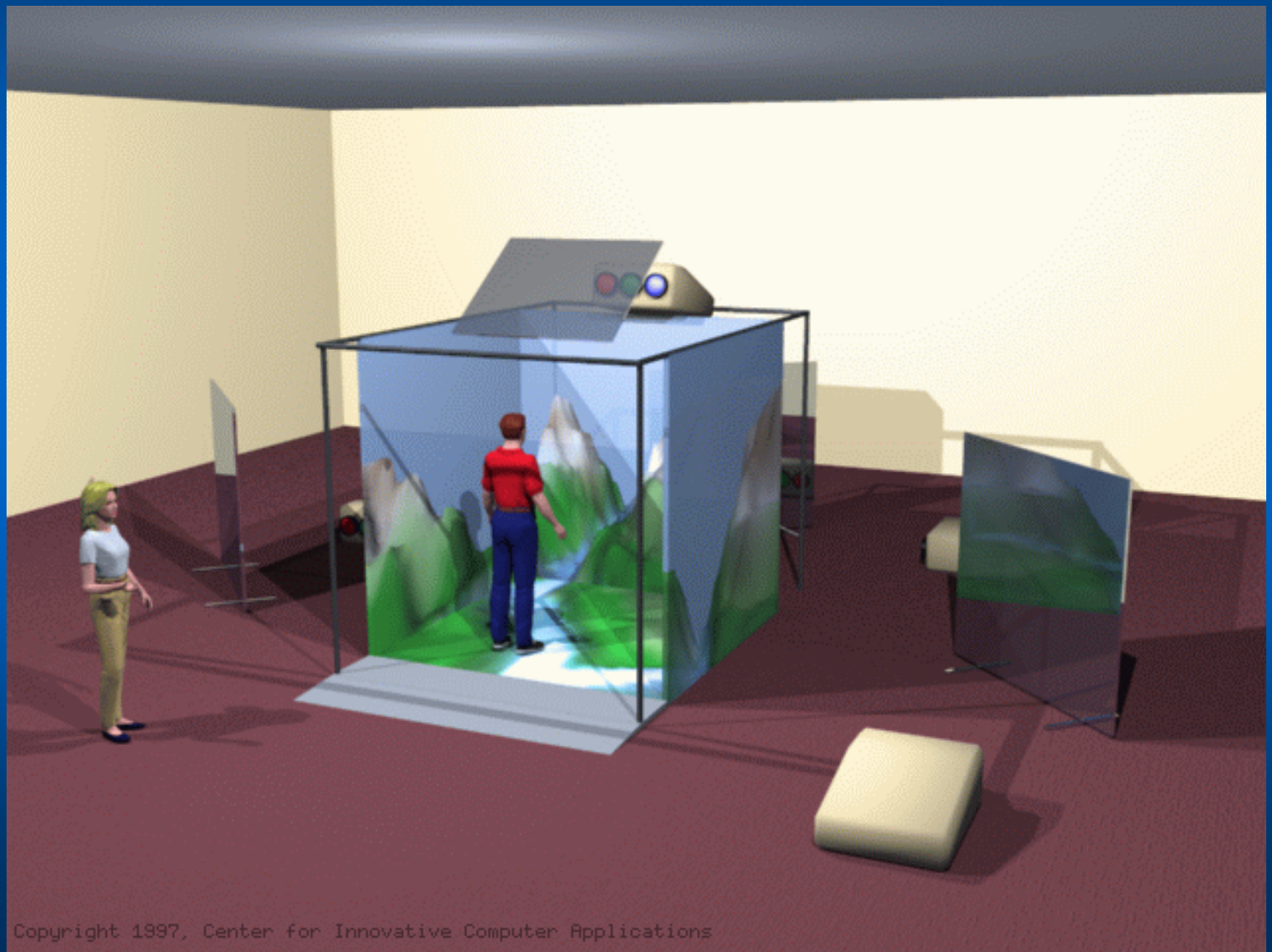


www.fhwa-tsis.com

Vissim Video 1

Vissim Video 2

CAVE Virtual Environment

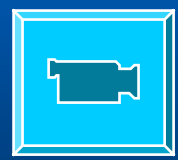


CAVE Virtual Environment

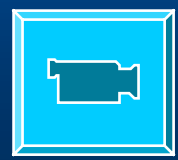
Design Virtual Environment

- Immersive, stereoscopic environment
- Walk-in or Head-mounted displays
- Accurate size and scale
- Multi-participant, collaborative design
- Easily navigable

EVL U of IL Video



DVE GATech Video



Stake-less Construction Technology

Mobile Digital Highway Measurements

TURNER-FAIRBANK
HIGHWAY RESEARCH CENTER

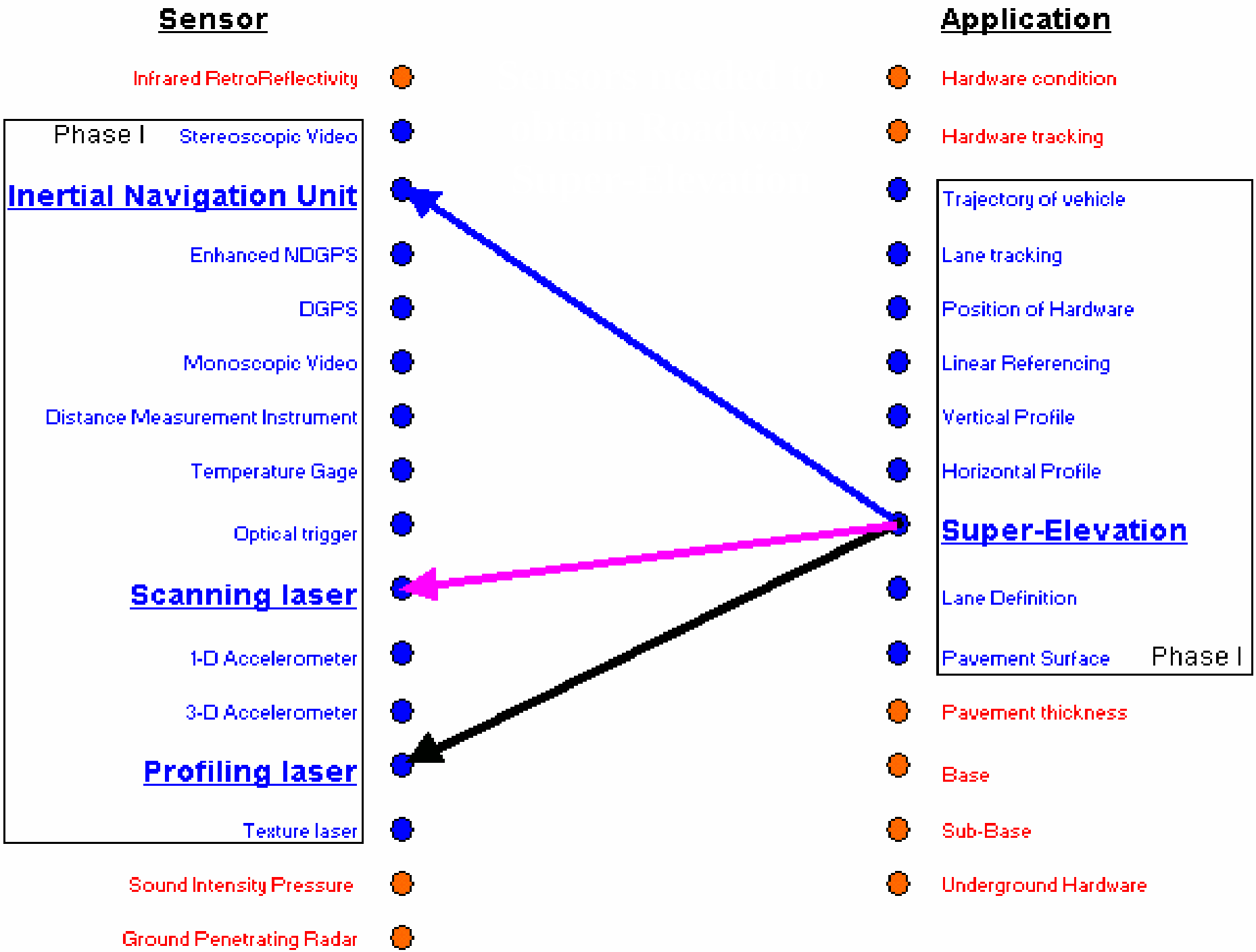
ADVANCED RESEARCH PROJECT

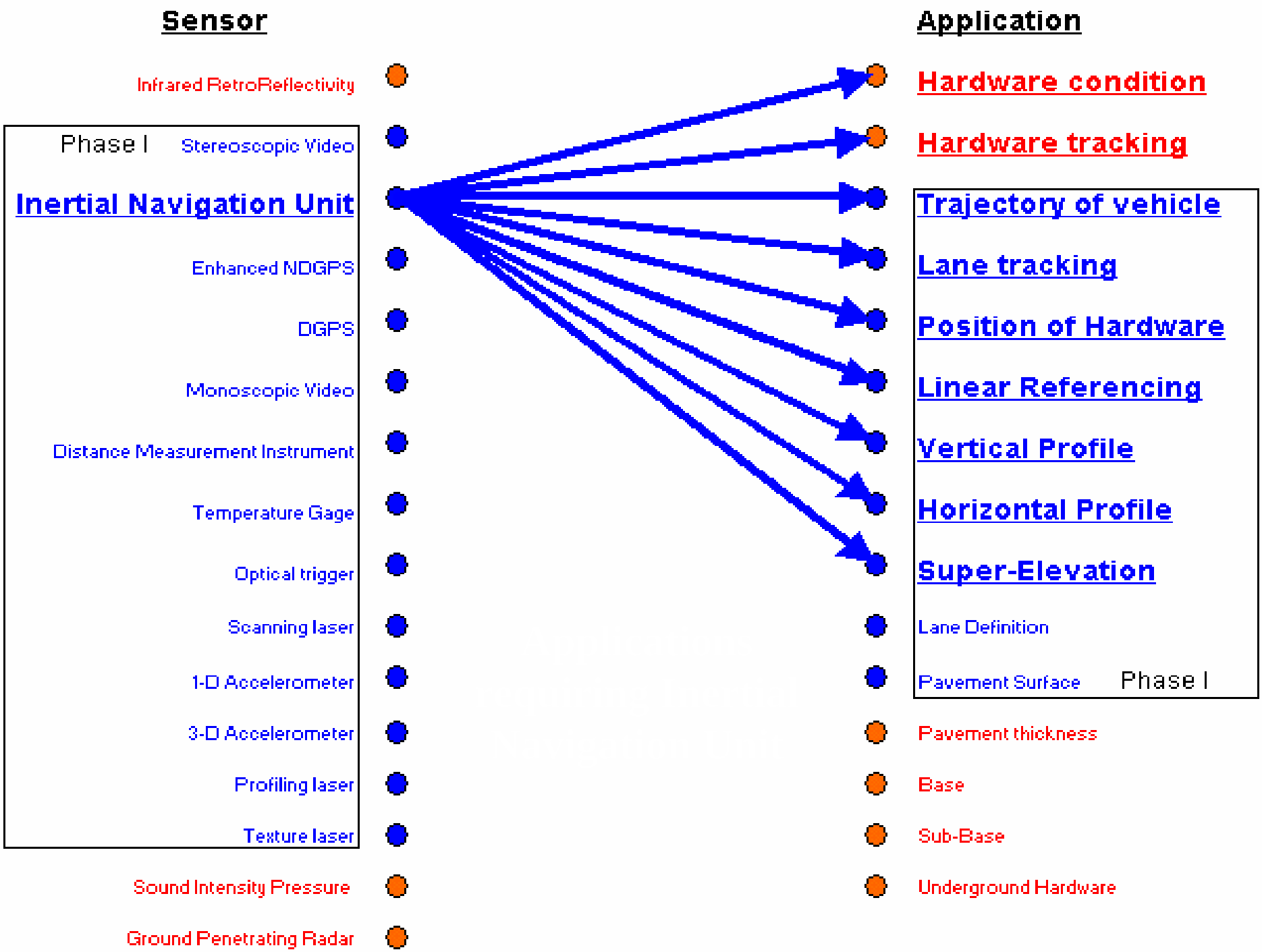
Measurement Needs

Vehicle and Phase I Sensors

Future Added Sensors

- Sound Intensity Pressure Device (SIPD)
- Ground Penetrating Radar (GPR)
- LIDAR
- Infrared Sign Retro-Reflectivity (IR)
- Downward facing Camera for Pavements


Sensor
Application
Infrared RetroReflectivity
Phase I
Stereoscopic Video
Inertial Navigation Unit
Enhanced NDGPS
DGPS
Monoscopic Video
Distance Measurement Instrument
Temperature Gage
Optical trigger
Scanning laser
1-D Accelerometer
3-D Accelerometer
Profiling laser
Texture laser
Sound Intensity Pressure
Ground Penetrating Radar
Hardware condition
Hardware tracking
Trajectory of vehicle
Lane tracking
Position of Hardware
Linear Referencing
Vertical Profile
Horizontal Profile
Super-Elevation
Lane Definition
Pavement Surface
Phase I
Pavement thickness
Base
Sub-Base
Underground Hardware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Vertical Profile
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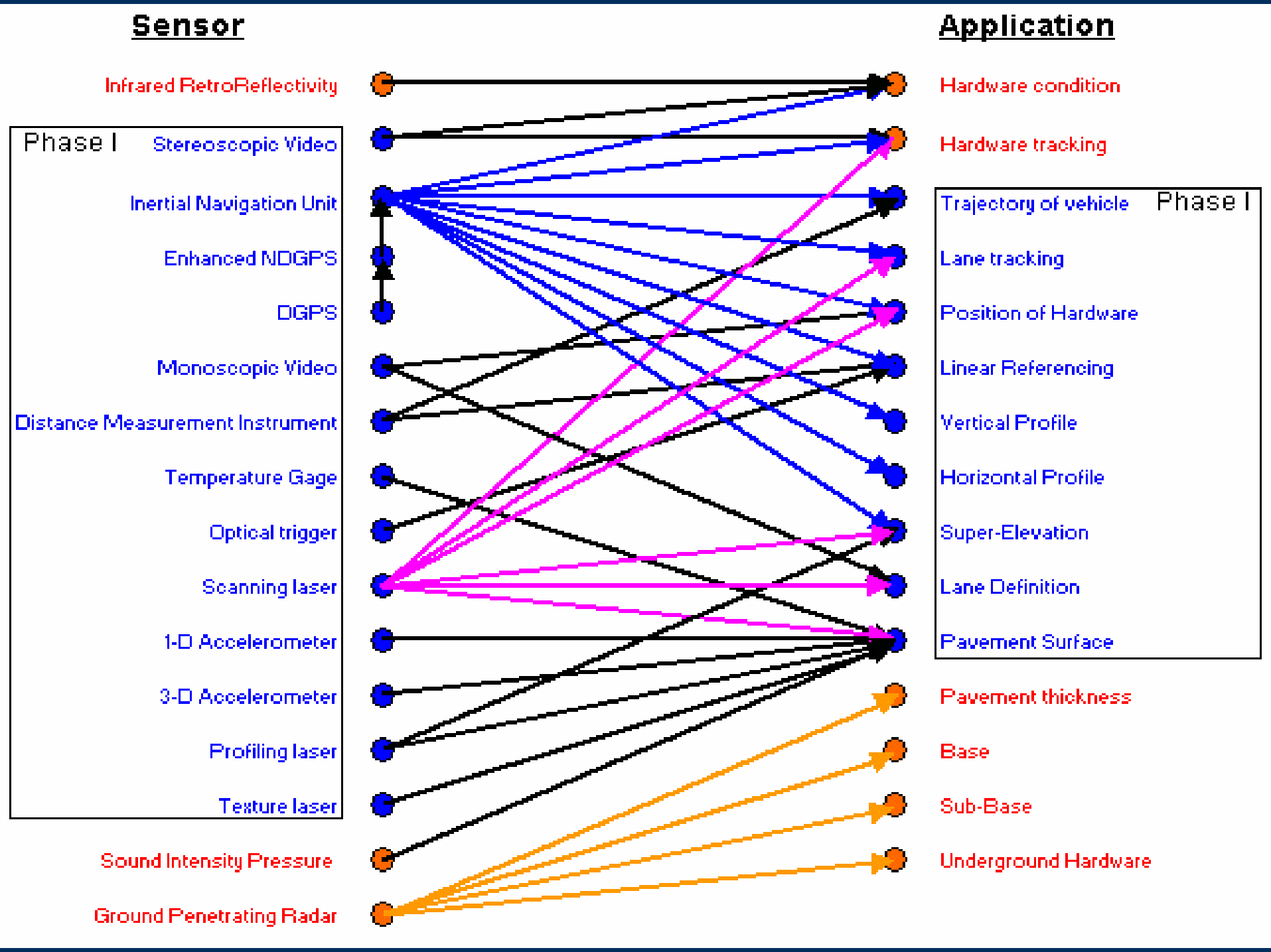
Pavement Surface
Phase I
Pavement thickness
Base
Sub-Base
Underground Hardware


Sensor
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Lane tracking
Position of Hardware
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Vertical Profile
Horizontal Profile
Super-Elevation
Lane Definition
Pavement Surface
Pavement thickness
Base
Sub-Base
Underground Hardware

DHM SYSTEM


Casename InitializeDLLs
Date 03-22-2004
Time 11:52:08
DAQ
Quit
Sensor Check
Geometry
Optical Trig.
Video
Temperature
Profile
Inclinometers
NDGPS
Aux. Hor. Acc.
Aux. Geometry
DMI Pulser
Noise
Rut Bar Calibration
DAQ System Selection
Geometry
HAGPS
Video
5.0 FPS
As Is
Profile
Image Height
Capture Definition
Exclude Pixels
Speed
(mph)
60


Digital Highway Measurement
Advanced Research Vehicle


CAUTION
40708

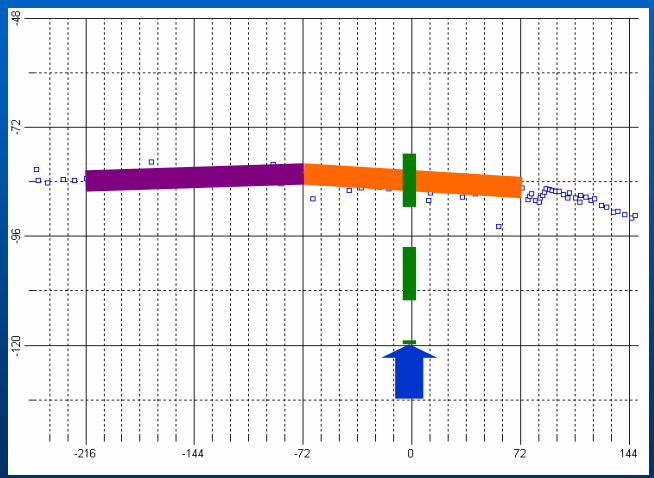
DHM DATA VIEWER

DHM STEREO IMAGING

LEFT CAMERA

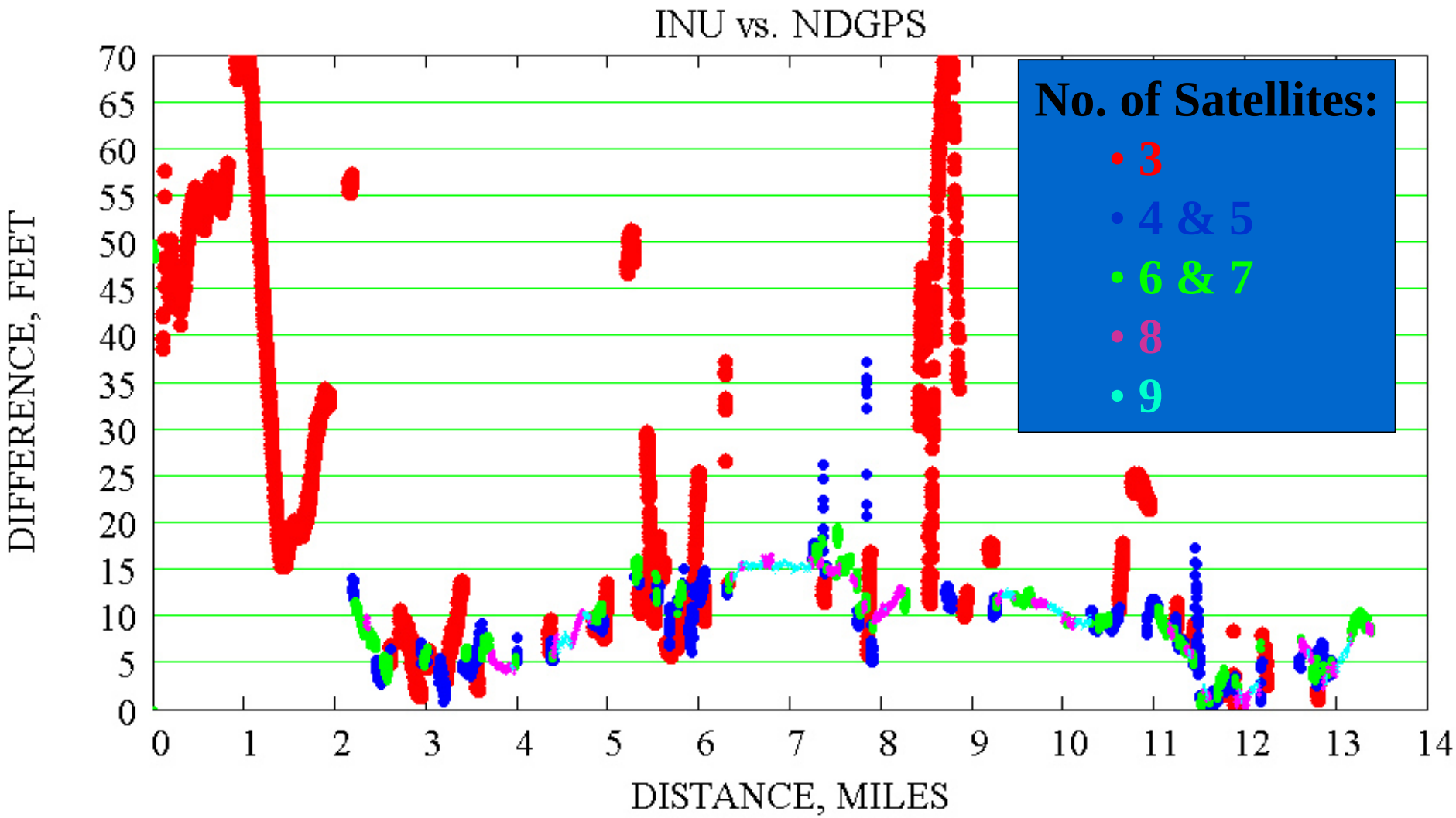
RIGHT CAMERA

LANE ATTRIBUTES



- LANE MARKINGS
- LANE WIDTH

GPS RECEPTION



Integrated GPS and Inertial

GPS Only

Advantages

- High accuracy position & velocity
- Moderate accuracy orientation (using multiple antennas)

Limitations

- Low bandwidth
- Satellite shading (dropouts)
- Slow ambiguity resolution

Inertial Only

Advantages

- Full 6 DOF solution
- High dynamic accuracy with broad bandwidth
- Self-contained (no dropouts)

Limitations

- Solution errors grow over time

Integrated Inertial/GPS/DMI

Advantages

- All inertial and GPS advantages
- DMI constrains noise and drift, and adds robustness

Limitations

- No significant limitations

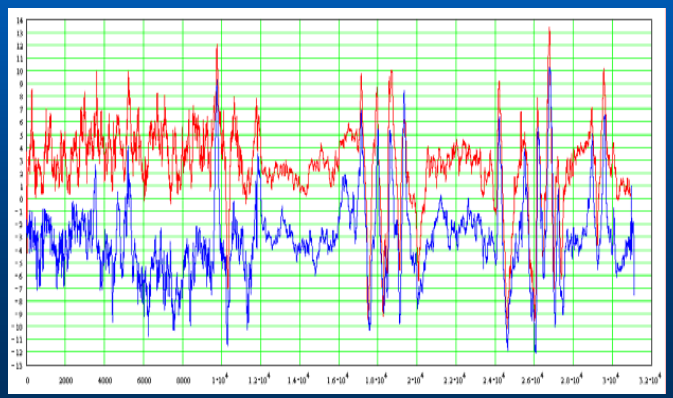
PHASE I APPLICATIONS

APPLICATION	PARTICIPANT		DATA ACQUISITION		
	STATE	FEDERAL	DHM	Federal Lands RIP	Other
1		Operations			As-built plans
2		Infrastructure			As-built plans
3		Highway Safety Information System			Static Laser
4	Penn DOT	Highway Driving Simulator			
5	VDOT	Interactive Highway Safety Design Module			Manual Survey

TYPES OF DATA

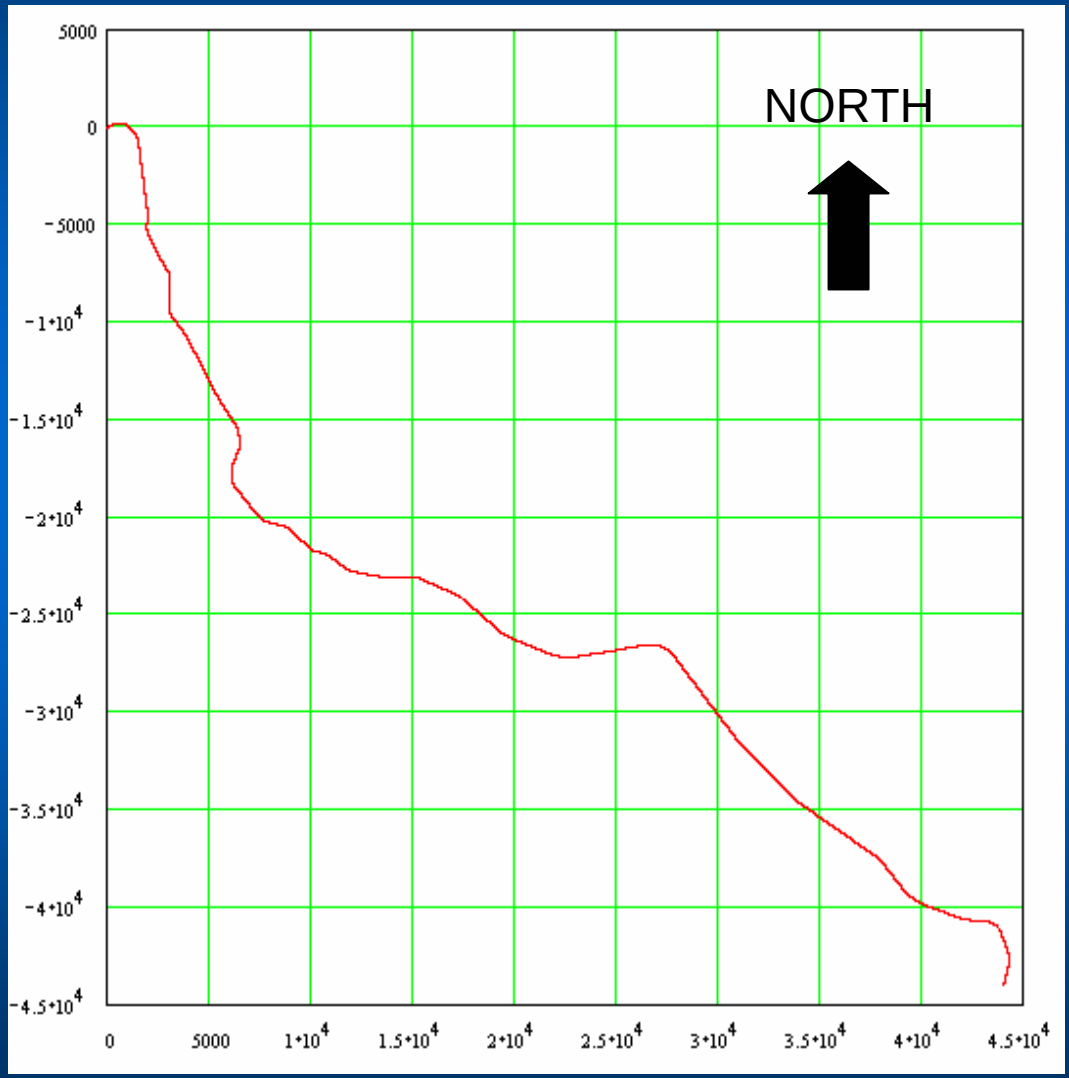
- VERTICAL AND HORIZONTAL ALIGNMENTS INCLUDING PC, PT, CURVE DATA
- SUPER ELEVATION
- LANE DEFINITION (MARKINGS AND EDGE)
- LINEAR REFERENCING
- ROADSIDE HARDWARE
- PAVEMENT SURFACE CONDITION

HIGHWAY GEOMETRICS



- HORIZONTAL ALIGNMENT
- VERTICAL ALIGNMENT
- SUPER-ELEVATION

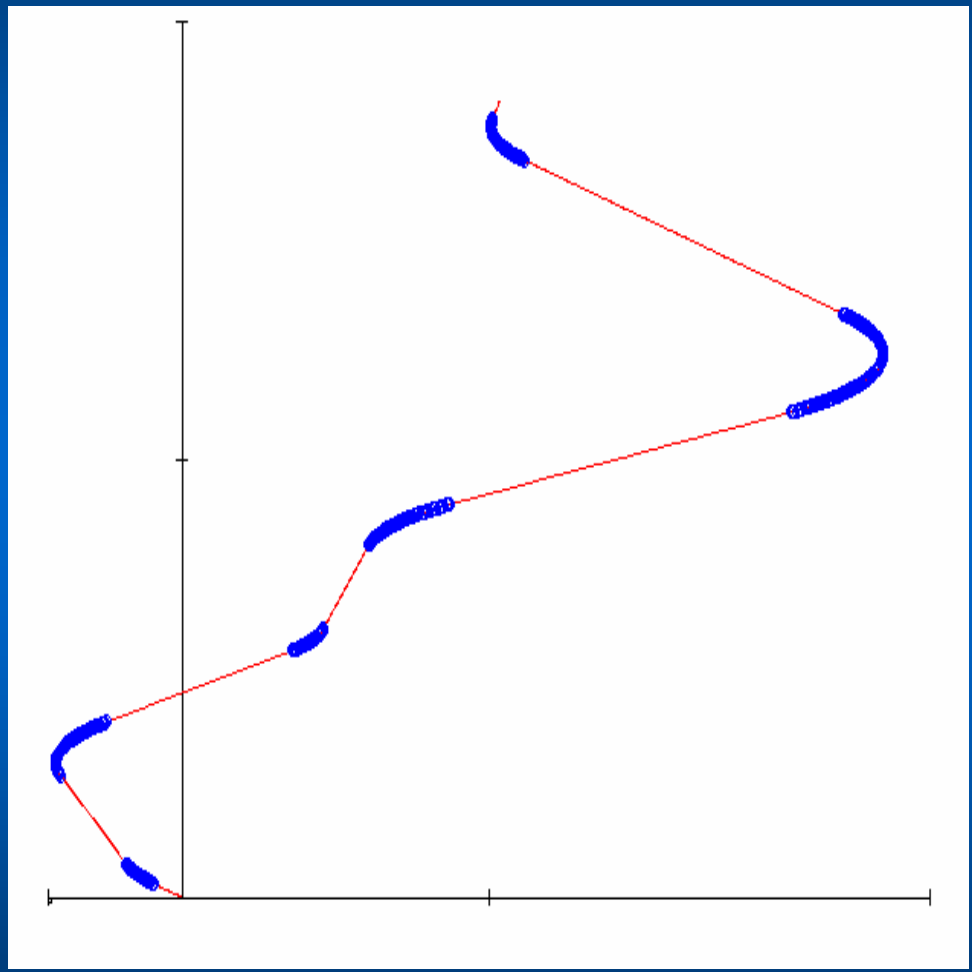
PLAN VIEW



PROJECT LATITUDE IN FEET

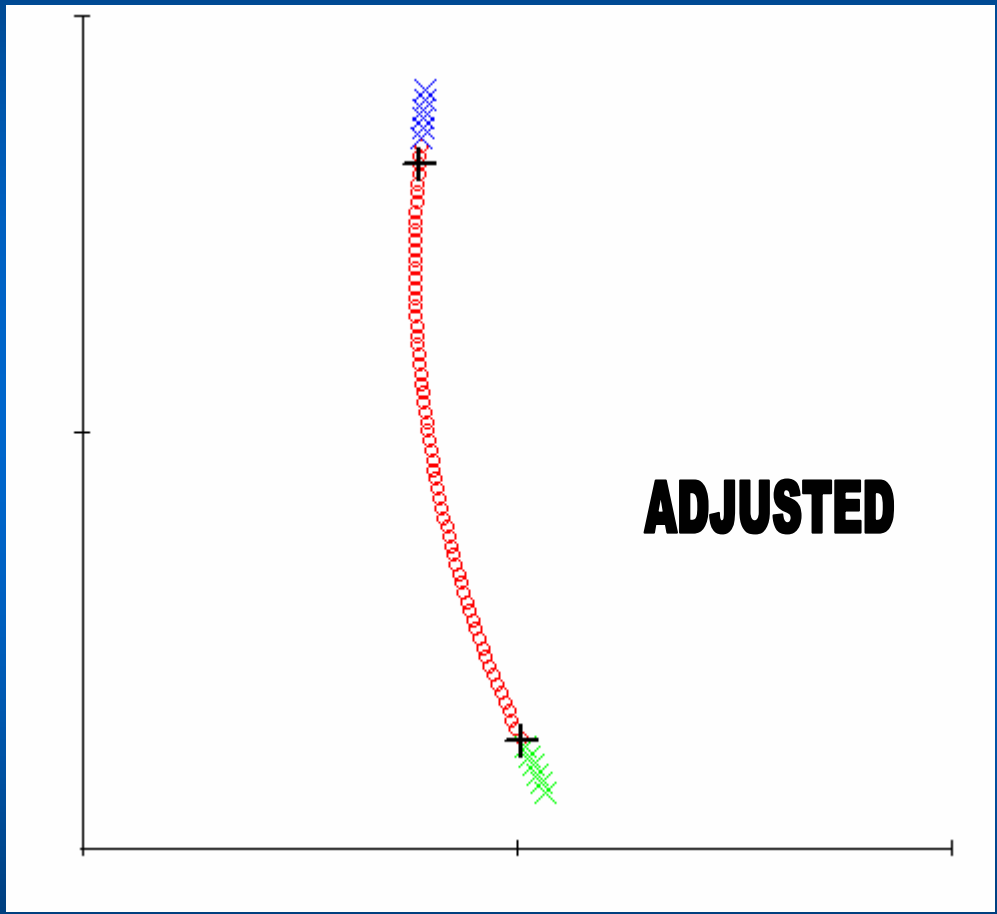
PROJECT LONGITUDE IN FEET

HORIZONTAL ALIGNMENT



Approximate PC = Point of Curvature and PT = Point of Tangency

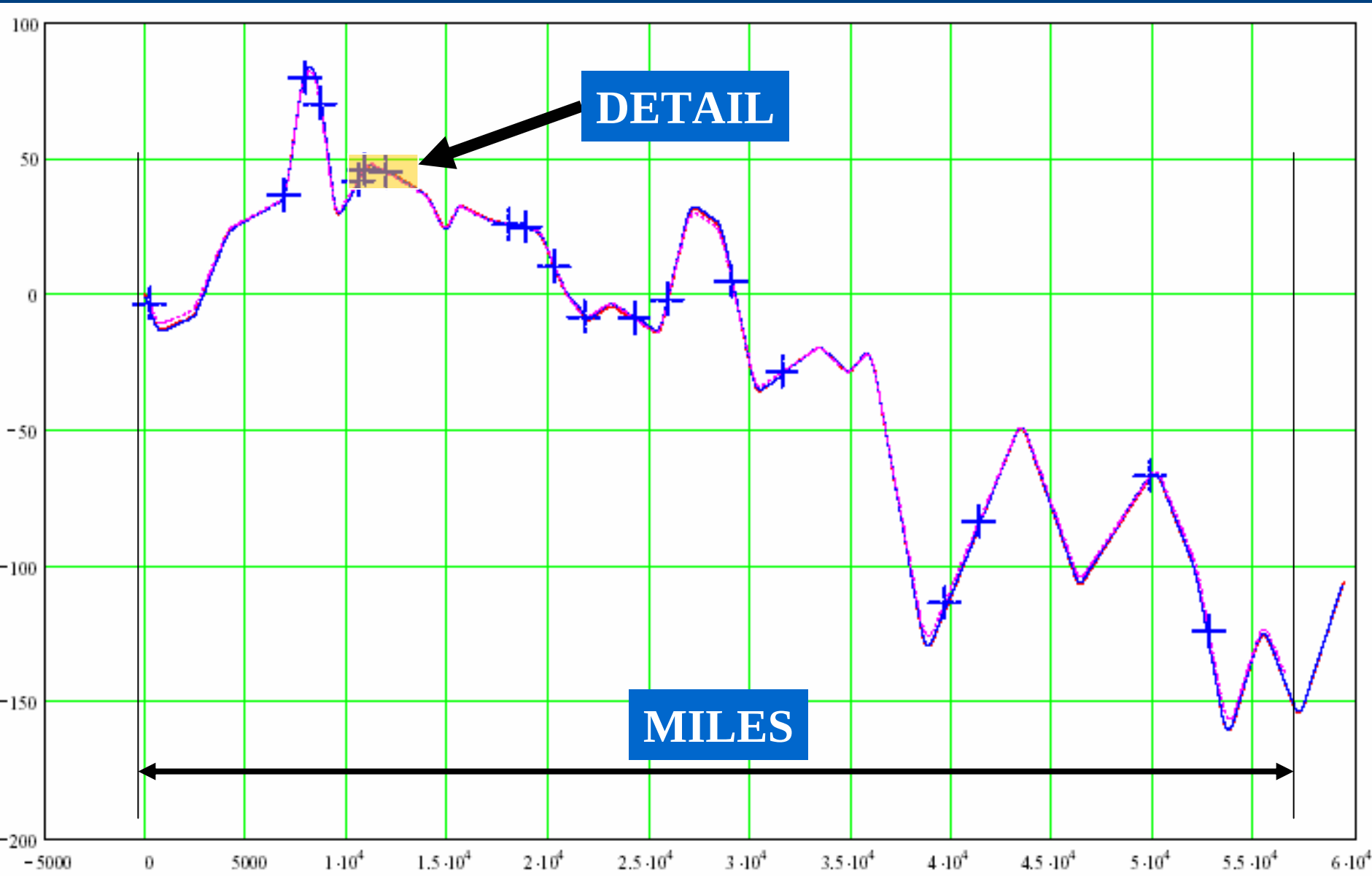
HORIZONTAL ALIGNMENT



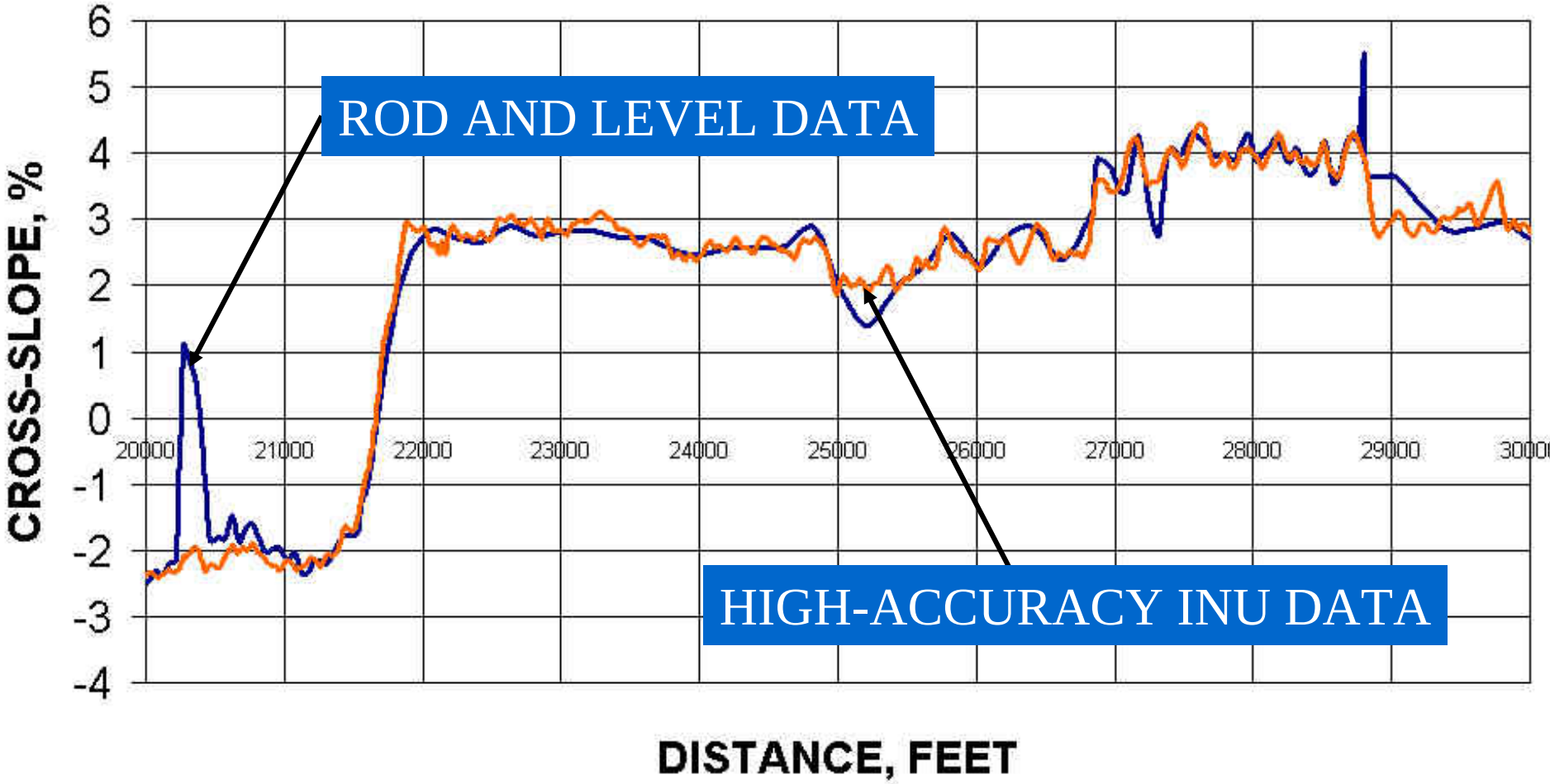
Refined PC = Point of Curvature and PT = Point of Tangency

ELEVATION VIEW

VERTICAL ALIGNMENT

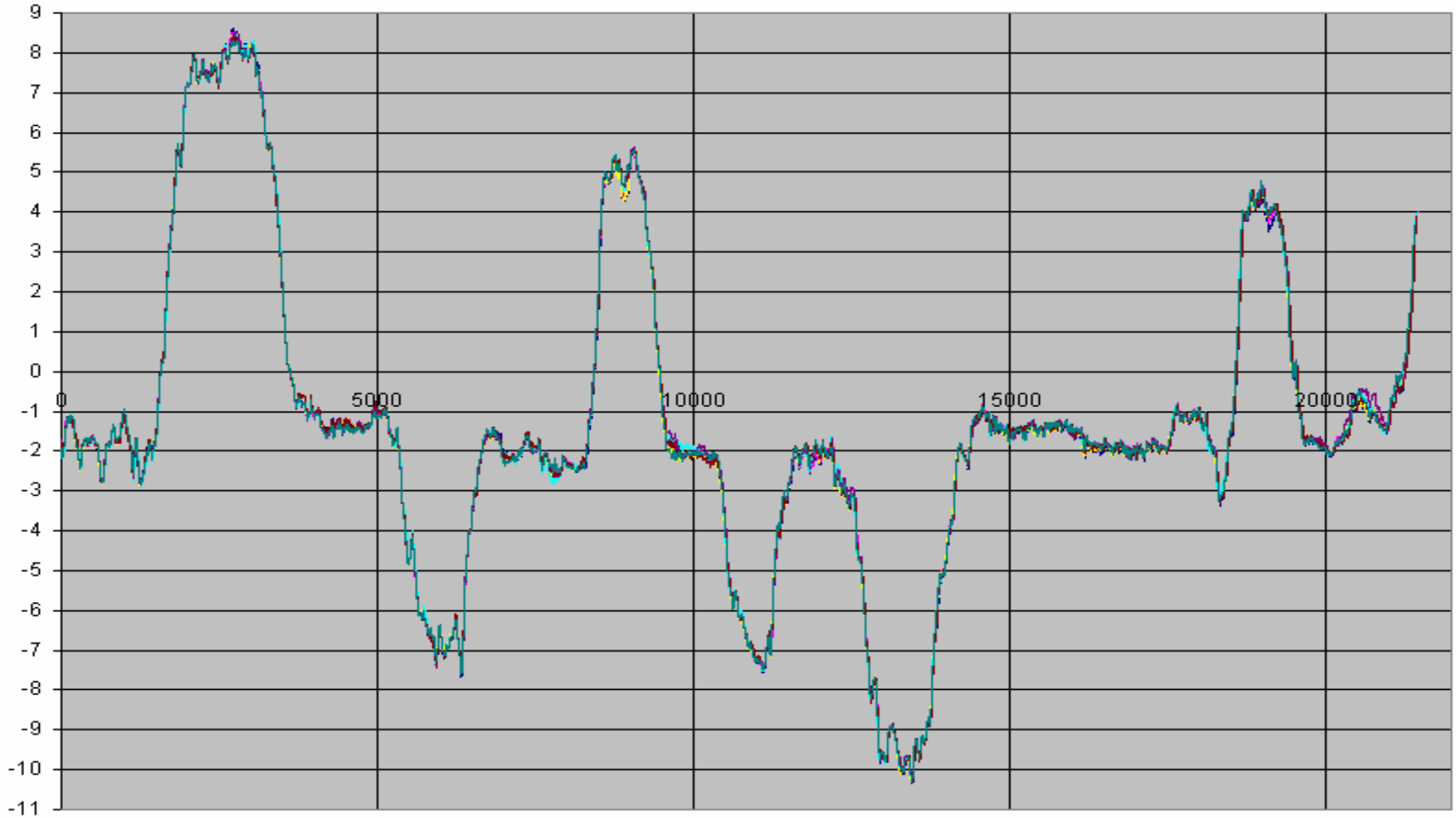


SUPER-ELEVATION



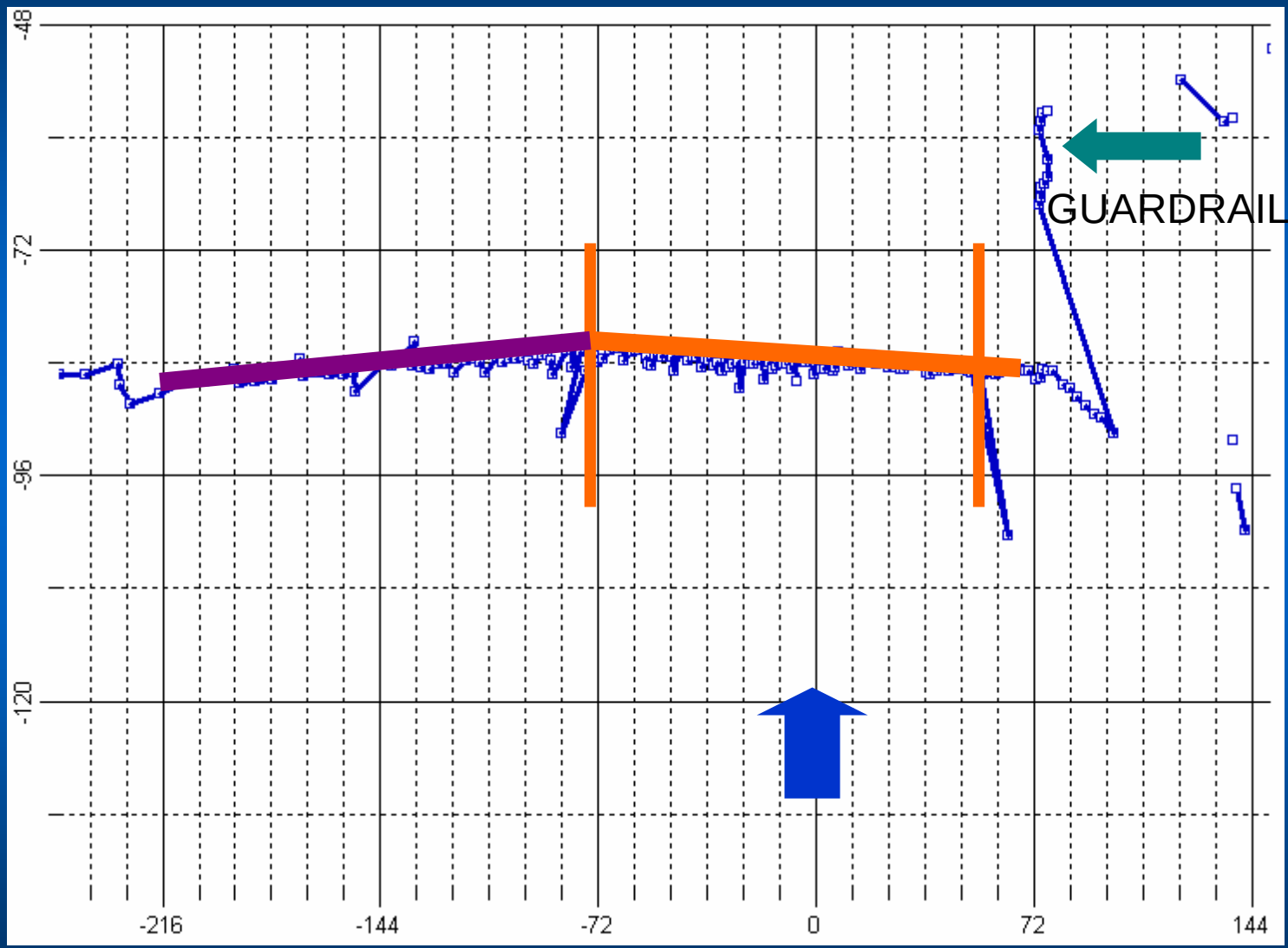
Comparison with rod and level data over 2 miles

SUPER-ELEVATION



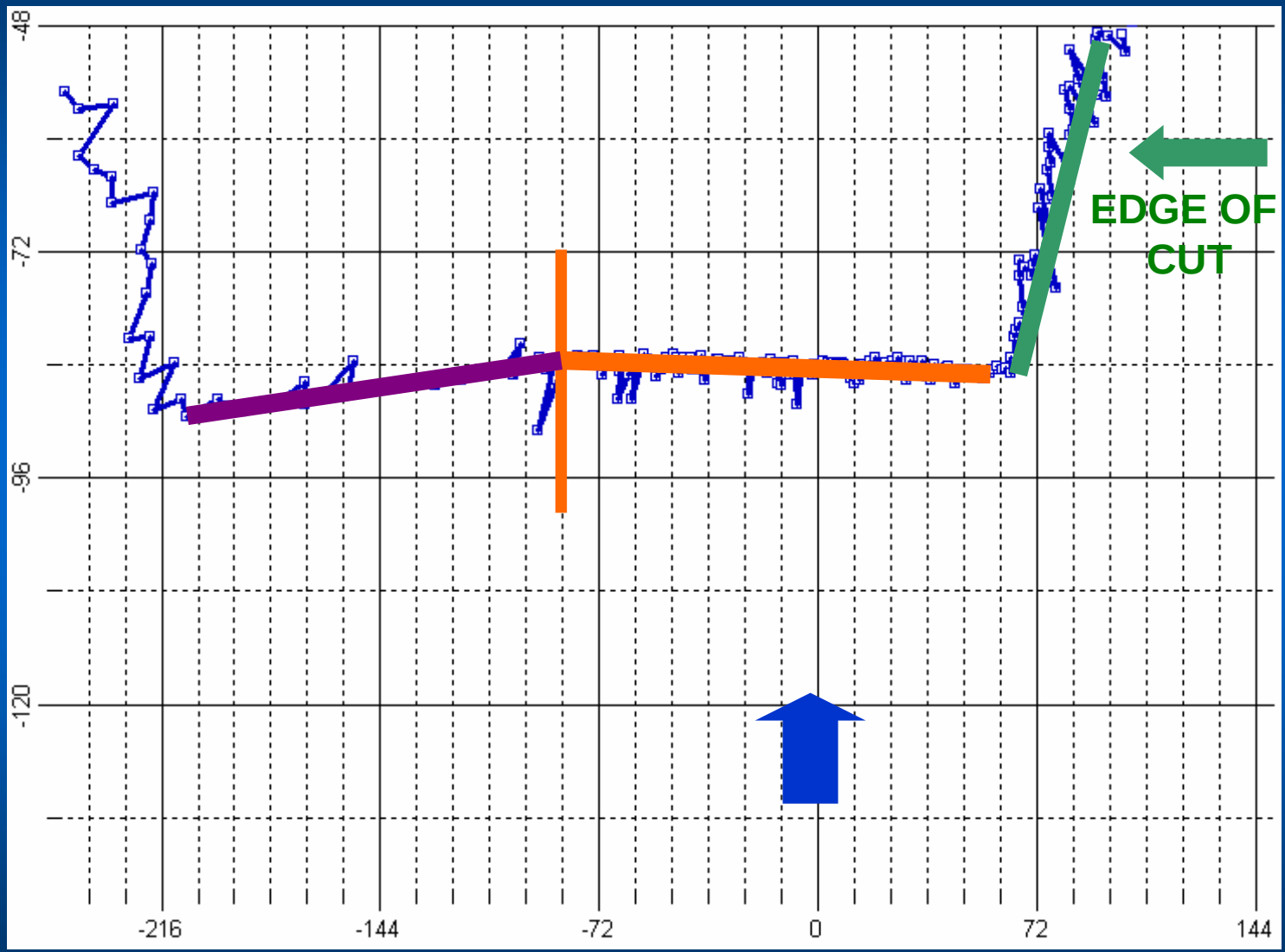
7 Runs Super-Imposed: Measured Precision = 0.02%

CROSS-SECTION SCANS

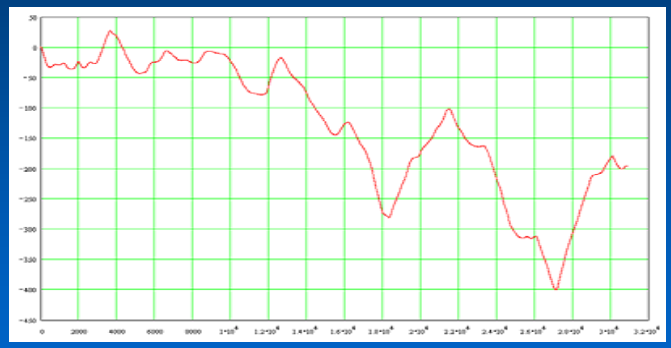


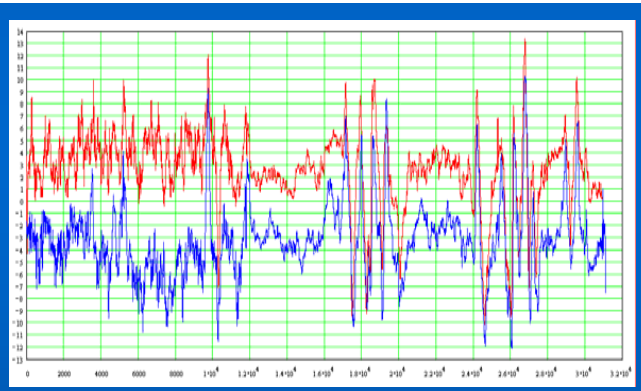
POSITION OF GUARD RAIL

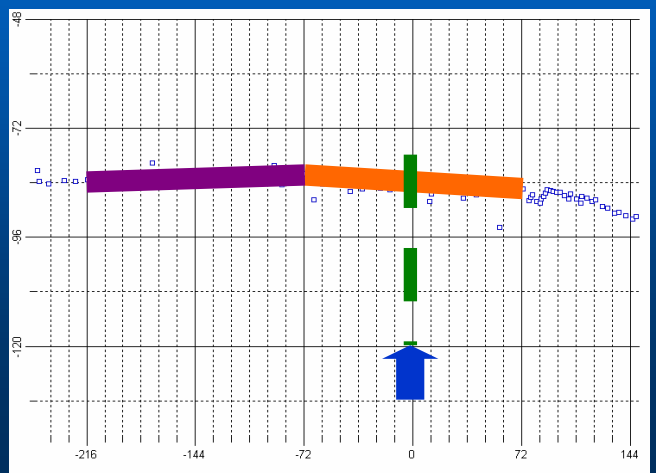
CROSS-SECTION SCANS



CROSS-SECTION PLOTS

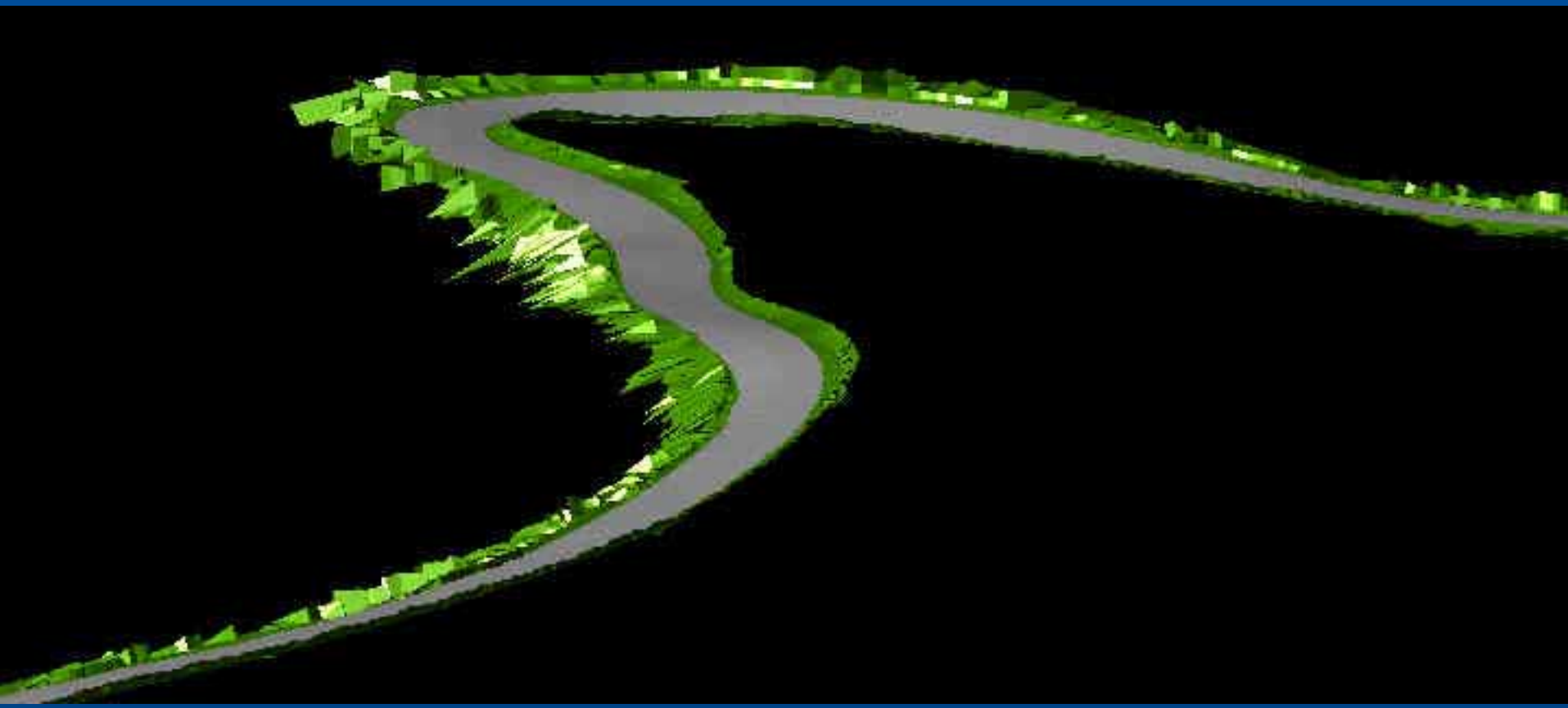






- ESTABLISHMENT OF A CONTROL LINE FOR LINEAR REFERENCING
- MERGE OF ELEVATIONS AND CROSS-SLOPES
- SUPERIMPOSED CROSS-SECTIONAL SCANS

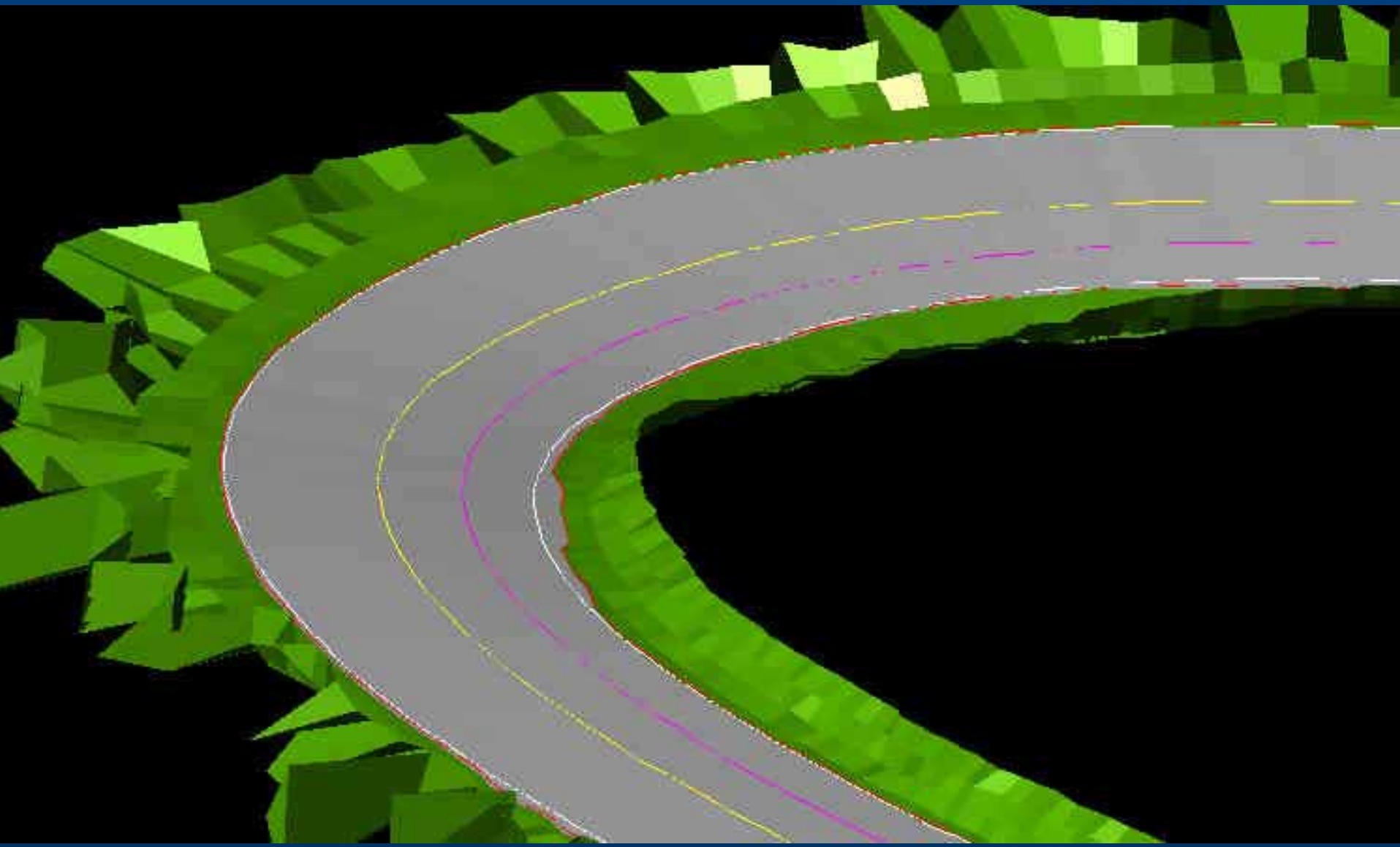
Visualization



3-D RENDERING OF ROADWAY SURFACES

Superimpose Digital Imagery

Visualization



3-D RENDERING OF ROADWAY SURFACES

Superimpose Digital Imagery

Summary

- Federal Lands Highway uses
  - Performance oriented design and CSS
  - State of the art design technologies
- To deliver facilities which are
  - Technically feasible and responsible
  - In harmony with their environment
  - Reflect community and natural values
- That satisfy user and stakeholder needs
  - Safety
  - Mobility

For More Information

- Federal Lands CSS Web Site:

  www.fhwa.dot.gov/csd/fed.htm

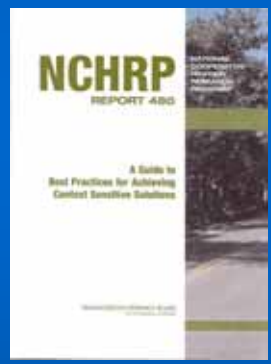
- NCHRP Report 480

  "A Guide to Best Practices for Achieving Context Sensitive Solutions"

- *WWW.ContextSensitiveSolutions.Org*

- *WWW.TRBVIS.Org*

"Commitment to Excellence"



Thank You

Mark Taylor
Design Discipline Leader

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Lakewood, CO 80228
(720) 963-3607
mark.taylor@fhwa.dot.gov

U.S. Department of Transportation
Federal Highway Administration

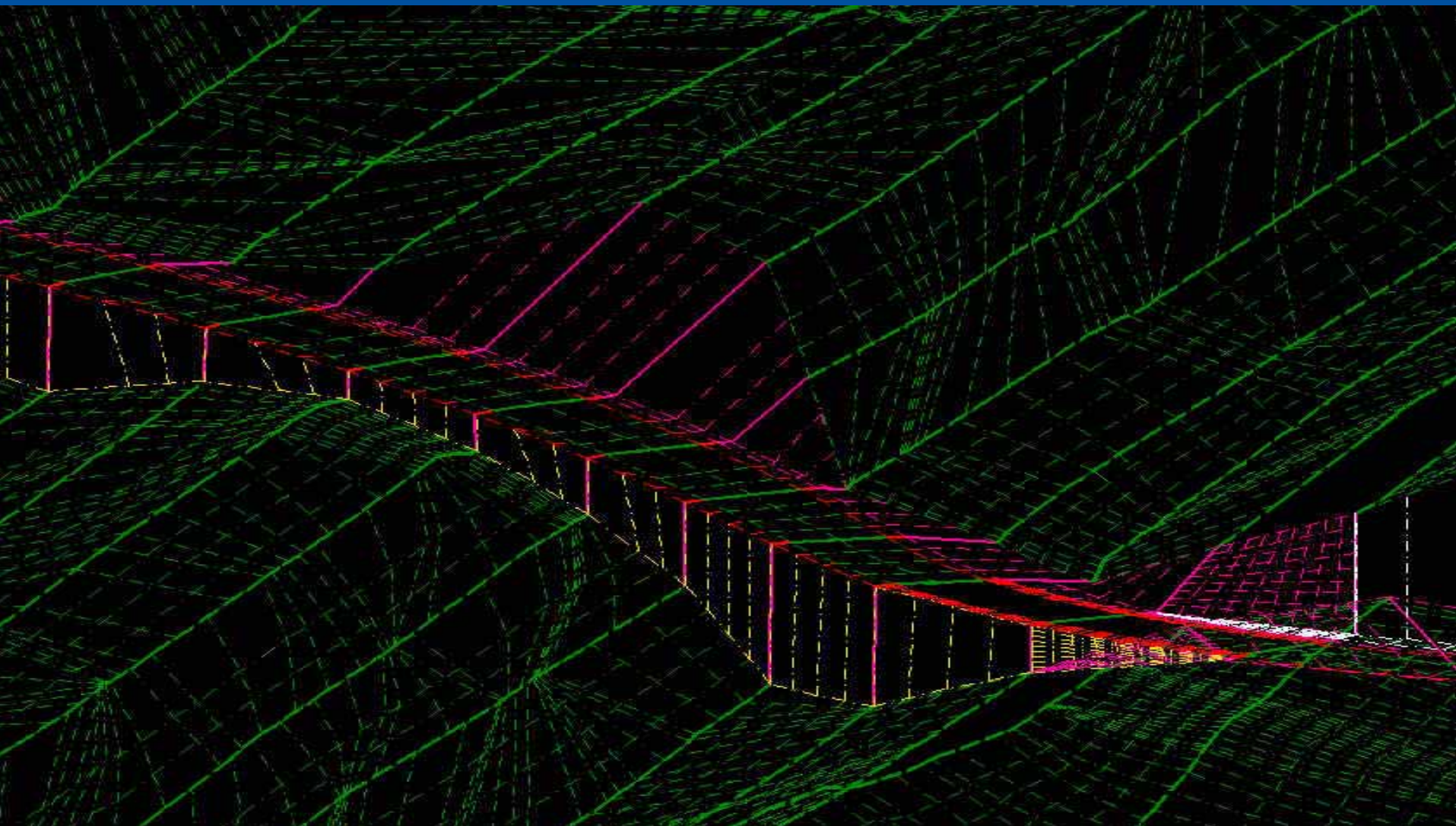
FEDERAL LANDS HIGHWAY

Photo-simulation Techniques

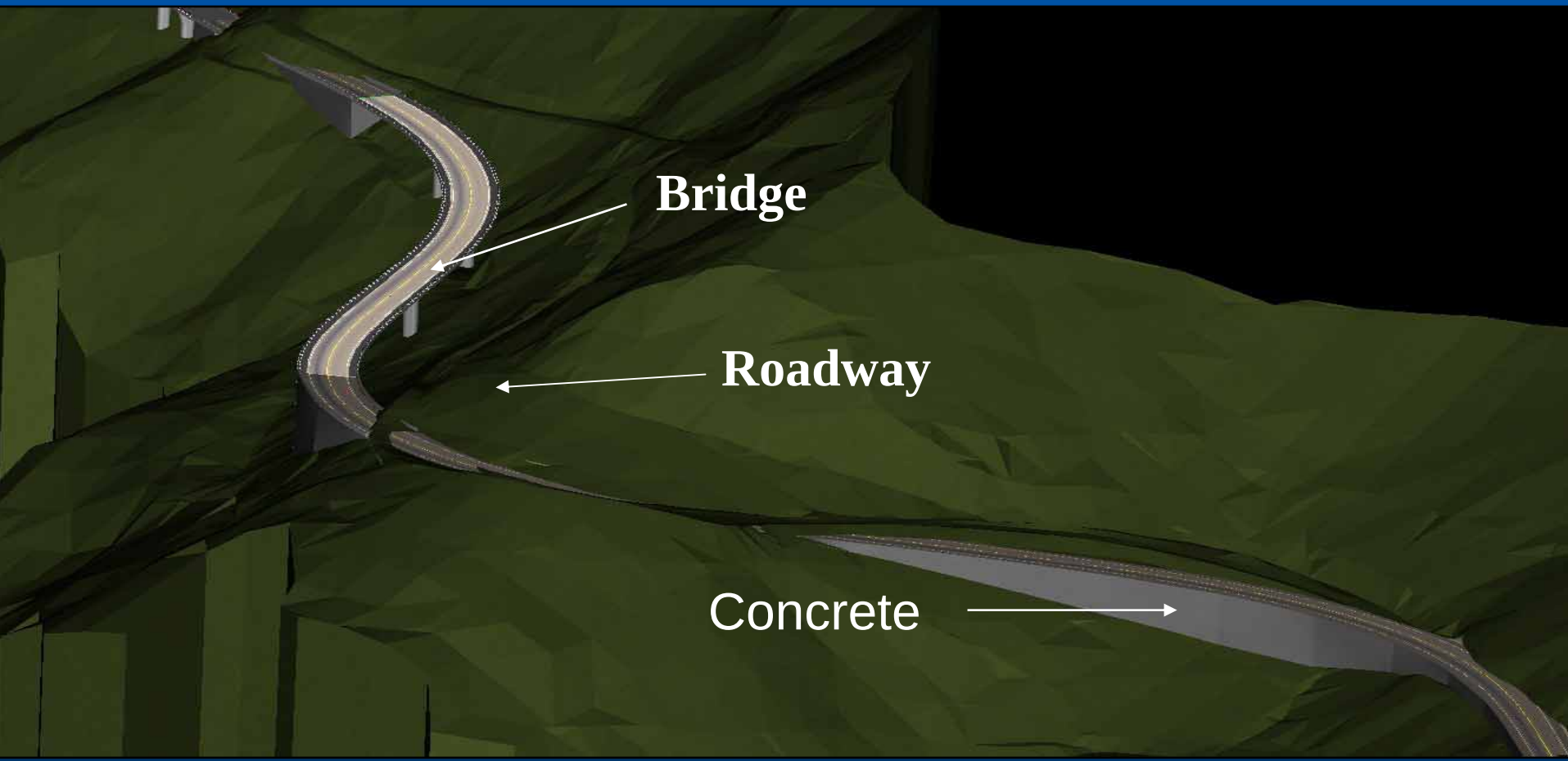
Data Furnished By Designer

- GEOPAK .gpk File
- Tin File
- Alignment Centerline Name
- Proposed Cross-Sections
- Roadway Criteria Files
- Structures TSL Info
- Structures Criteria Files

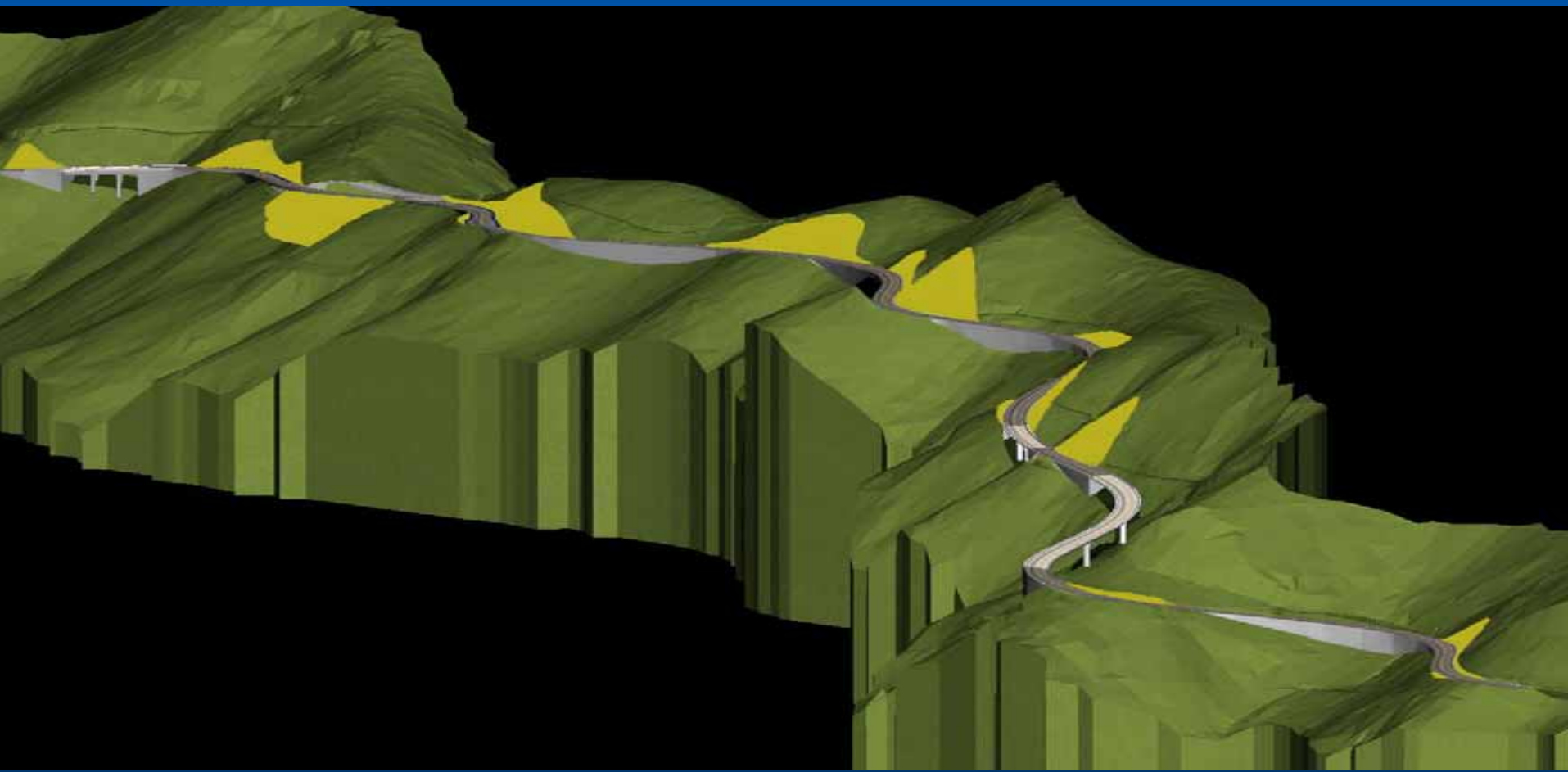
Run 3D Cross-Sections



Apply Surface Texture Materials



Apply Surface Texture Materials



Apply Lighting

Superimpose Photography

Photo Simulation Examples

8th Street Urban Street Improvements, Wash DC

8th Street Urban Street Improvements, Wash DC