Gravel Roads

Materials

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- 40 years in Transportation Maintenance, Construction and Design
- 19 years with the Idaho Transportation Department
- 13 years with the Idaho T2 Center
- Retired August 2013

Unpaved Road Dust Control and Stabilization Treatment Selection Guide

Acknowledgement

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Course outline and timing (Continued)

- Grading Unpaved Roads February 3, 2021 (10:00 – 12:30 pm)
  - Grading
  - Moisture
  - Compaction
  - Signage

Shape


GRAVEL ROAD MAINTENANCE:
MEETING THE CHALLENGE
PLAY ALL
INTRODUCTION
CORRECT ROADWAY SHAPE
SHAPING THE ROADWAY
GOOD SURFACE GRAVEL
DUST CONTROL
ADDITIONAL RESOURCES

The motorgrader operator must understand the correct shape needed on the roadway.

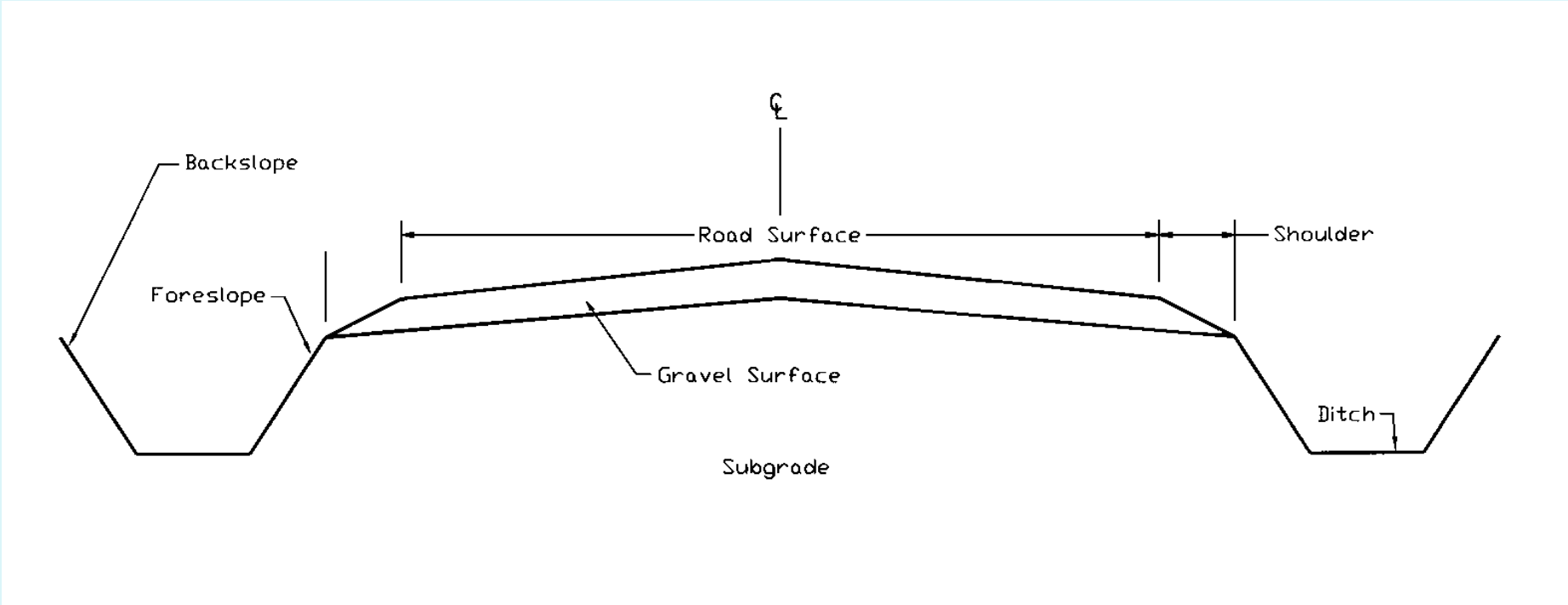
- There are special shaping situations such as driveways, intersections, bridge approaches, etc. that need to be understood as well.

- But thereafter, how a gravel road performs depends on quality and quantity of the surface gravel.

- Washboards, excess loose material, and excessive windrows are primarily due to poor quality of surface gravel.

Maintaining Gravel Roads

- Crown of roadway- 4 to 5%
- Ideal foreslope 4:1
- Backslope 2:1



How to check your slope.

Maintenance

- Cut to the bottom of the potholes, corrugations
- Remix the material with moisture to reduce segregation
- Reshape roadway
- Compact

Compaction?

Compaction

- Almost all treatments require compaction
- All treatments improve w/compaction
- Cheapest treatment to apply
- Compaction = right size roller for the right material and properly used


Compaction with Water Truck

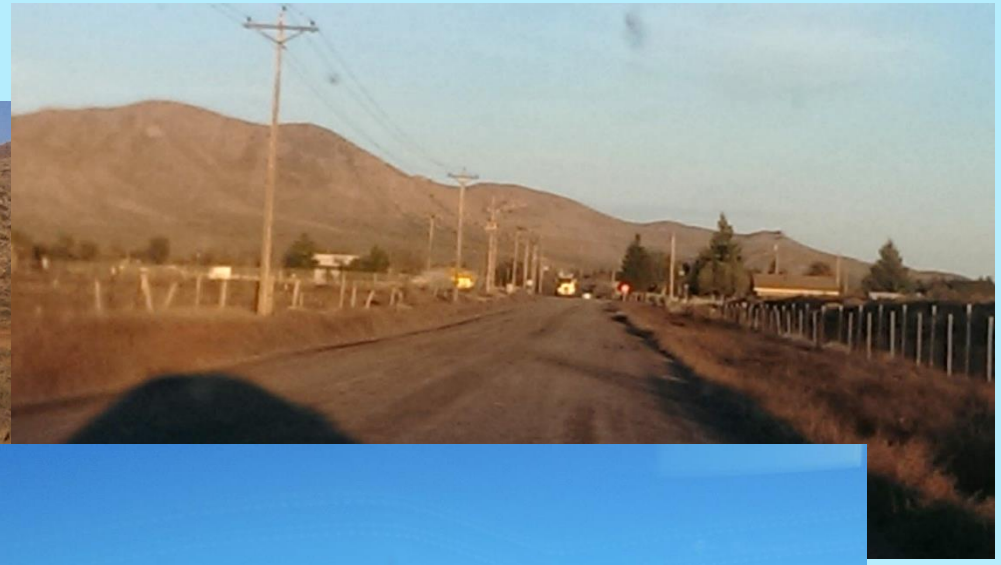
Guidance on Temporary Traffic Control for Unpaved Roads

Introduction

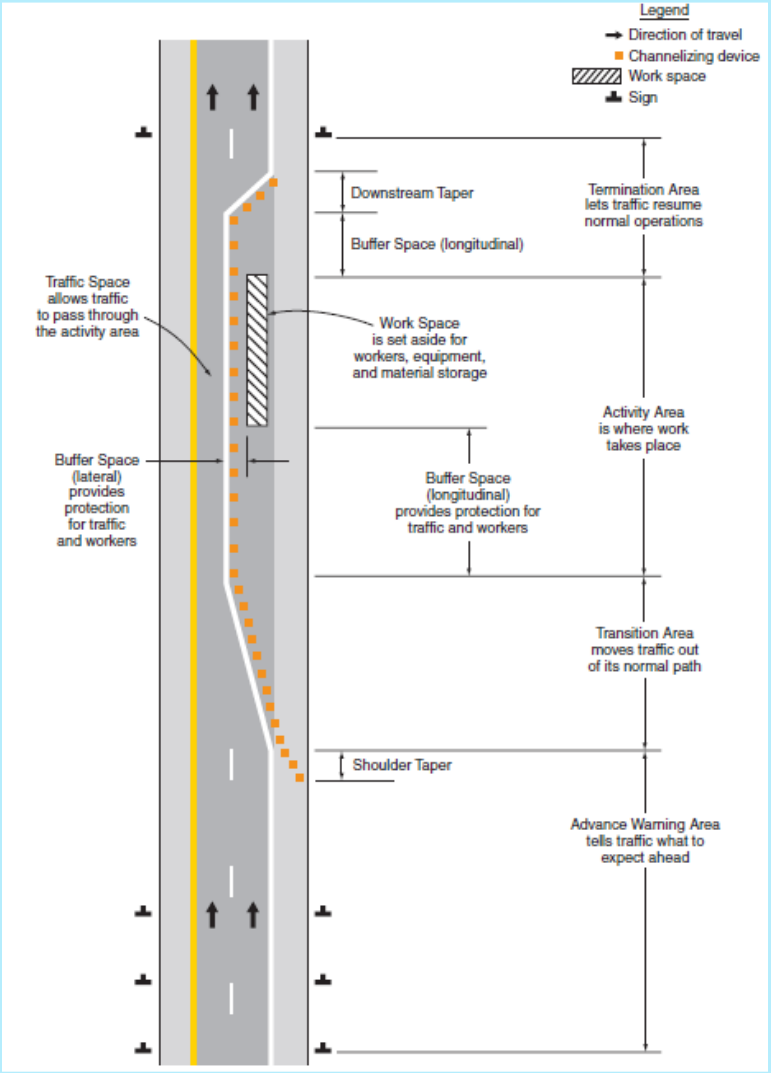
Nationally, unpaved roads account for over one third of the federal, state and local transportation systems (1). These roadways typically:

- Serve less than 3000 vehicles per day,
- Are primarily located in the Central and Mountain regions of the United States
- Are used by a wide range of vehicles (automobiles, farm equipment, large trucks, etc)
- Speeds can be fairly high (i.e., 55 mph or more), depending on the location and characteristics of the roadway

Unpaved Roads



MUTCD Traffic Control Concepts



Concerns

When maintaining unpaved roads, the organization needs to consider:

- Width and length of the work area,
- The visibility of the equipment and the berm to the traveling public,
  - What is reducing the visibility:
    - The Geometrics of the road,
    - Dust, created by the road surface and/or the maintenance activity.

Concerns

- The direction that the equipment will need to operate:
  - With the flow of traffic,
  - Opposing the flow of traffic.
- The size of the berm or drop off, which both move as the work is performed.

Activity Area for Unpaved Roads

Activity Area is located between the first point where the motor grader cuts the road surface or the road surface has changed, to the point were the traffic is returned to a roadway that has not been changed as the result of this maintenance activity.

Light Grading

Used when the berm is small enough to be traversable and drivers can see sufficiently ahead to safely pass the work operation.

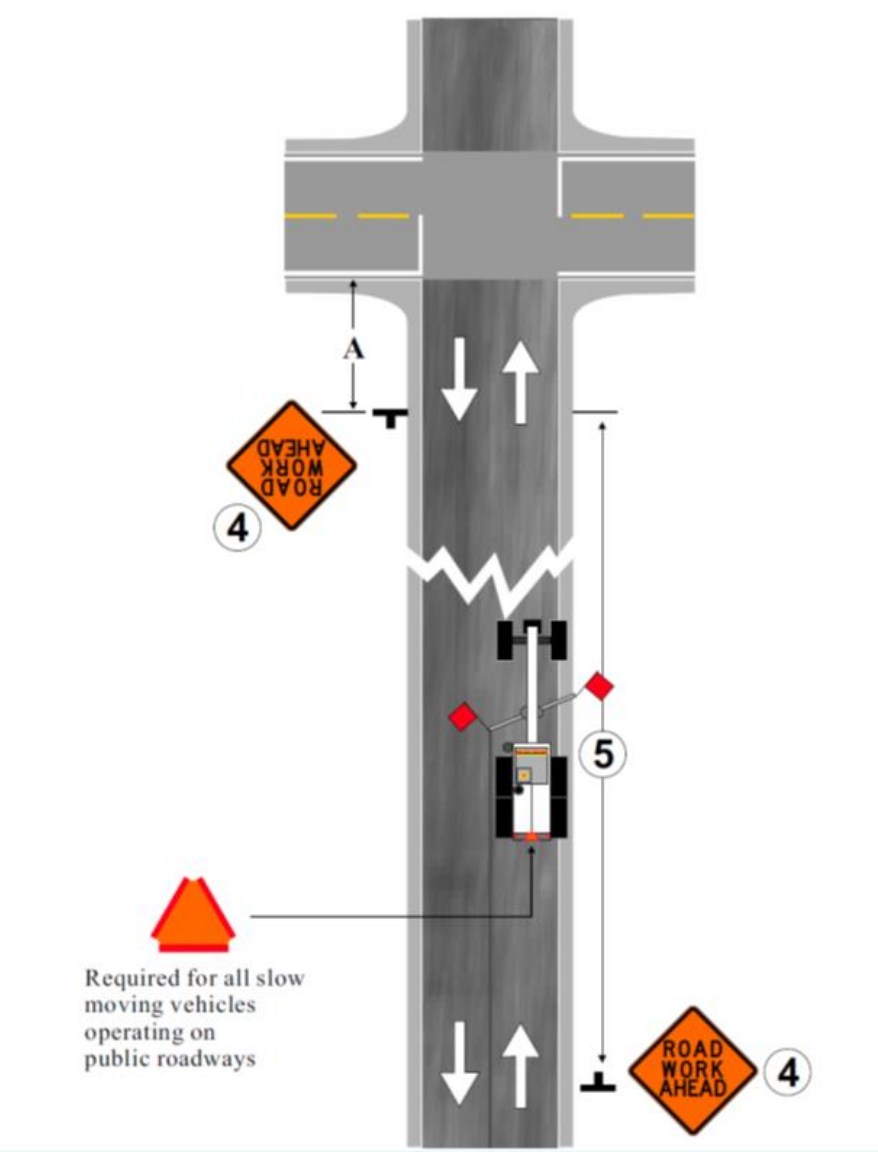
Surface Reshaping

Used when the berm is too high to be easily traversed, and so flaggers (or other appropriate devices) are needed at each end of the transition area, activity area and termination areas to positively control the flow of traffic through the work space in the open travel lane.

Reconstruction using a Detour

Used when the berm and/or other work is so significant that the workspace takes all of or the majority of the road surface, leaving no room for traffic to negotiate past the work activities.

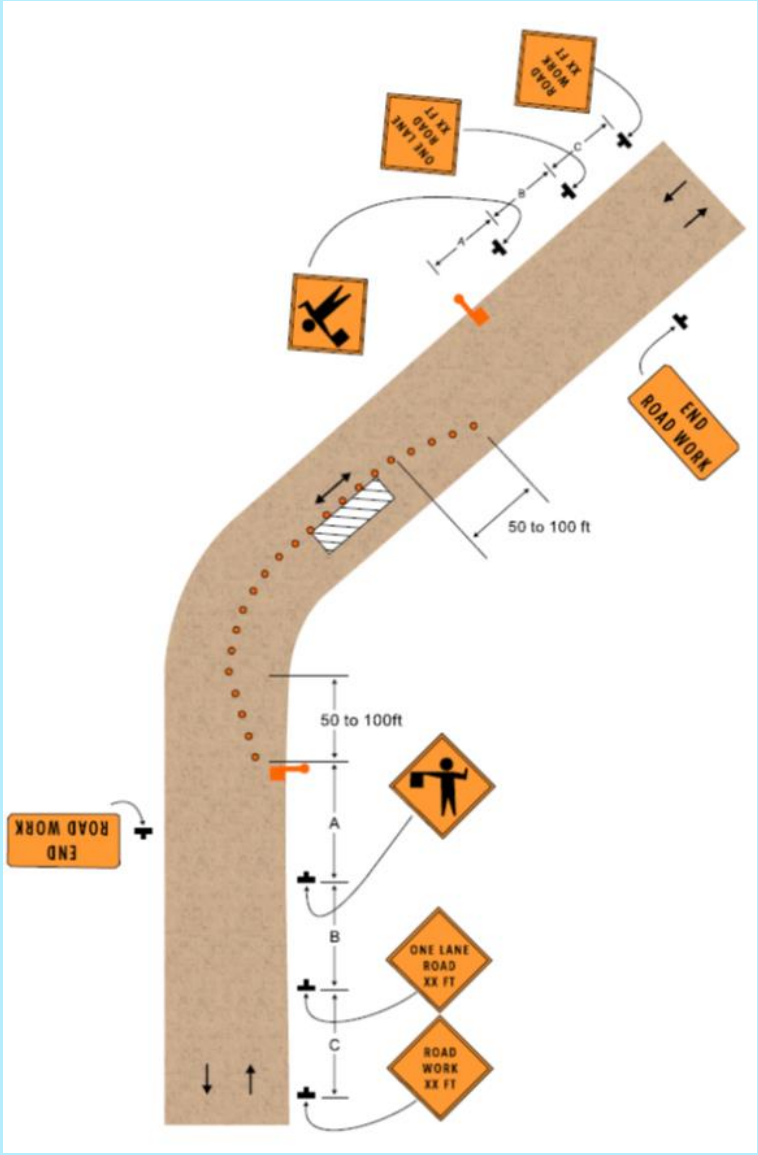
Light Grading



Notes:

1. Grading operations should be scheduled and completed during daylight hours and suspended during poor weather or visibility conditions.
2. When grading it is best to have moisture present to keep from segregating the material and creating additional dust that would reduce the visibility of the operation.
3. The ROAD WORK AHEAD signs should be installed at the approach of each cross road or street but no more than three miles from the maintenance operation.
4. When doing minor grading (with a berm less than six inches) the “ROAD WORK AHEAD” sign can be omitted, when there is adequate decision sight distance so that the equipment can be seen by the drives approaching the equipment from either direction. All warning and rotating lights need to be operating.
5. Motor Grader should be equipped with flashing or rotating light in addition to the vehicle’s hazard lights. Flashing or rotating lights should be visible 360 degrees around the motor grader when viewed from a distance of 600 feet.
6. Motor grader should be equipped with a “Slow Moving Vehicle” sign.
7. The motor grader blade ends may be equipped with orange flags to provide additional warning and visibility to the passing vehicles.

Surface Reshaping



Notes:

1. Conditions represented are for work that requires closing one traffic lane during daylight hours only.
2. This layout is intended for traffic volumes of less than 1500 vehicles per day.
3. All personal vehicles, work vehicles, equipment, etc. should be parked away from the one-lane section.
4. If the closed section of lane is short, the volume of traffic is low and the traveling public can see the oncoming traffic from other end of the work zone, the flaggers can be replaced by a YIELD TO ONCOMING TRAFFIC sign in lieu of the BE PREPARED TO STOP sign. The FLAGGER AHEAD signs would also be removed. (See 2009 MUTCD Typical Application 11, on page 655.)
5. The number of channelizing devices needed is based on the speed of the traffic or speed limit. Devices should be spaced at a distance in feet equal to the speed or speed limit in mph.
6. The work in the closed lane should permit a remaining opposite lane width of 10 feet. Nine feet is acceptable for short-term use on low volume, low-speed roadways for traffic that does not include longer and heavier commercial vehicles.
7. A distance supplemental plaque may be used below the symbolic Flagger Ahead signs if desired.

Course outline and timing (Continued)

- Materials
  - Subgrade Material
    - Types of Material
    - Frost?
  - Unpaved Road Material
    - Traffic and Materials
    - Specifications of materials
    - Testing
  - Maintenance of a Gravel Road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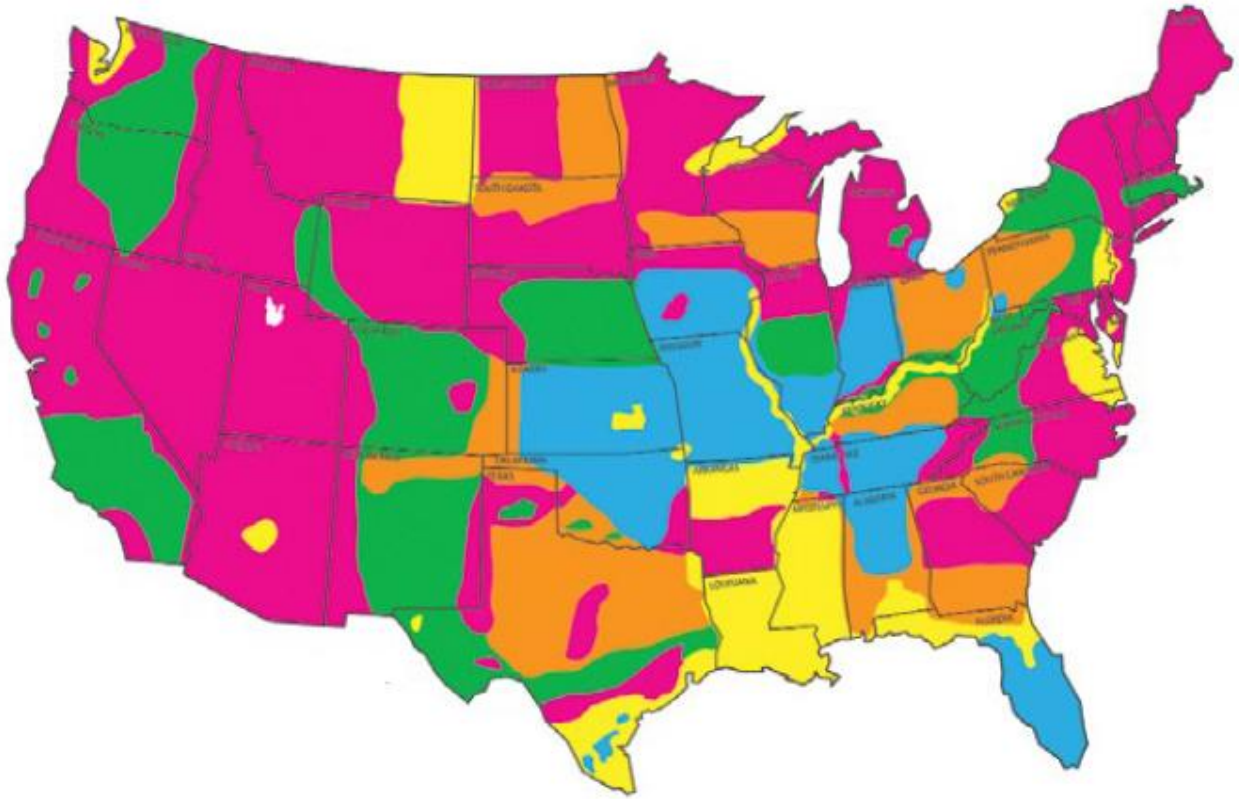
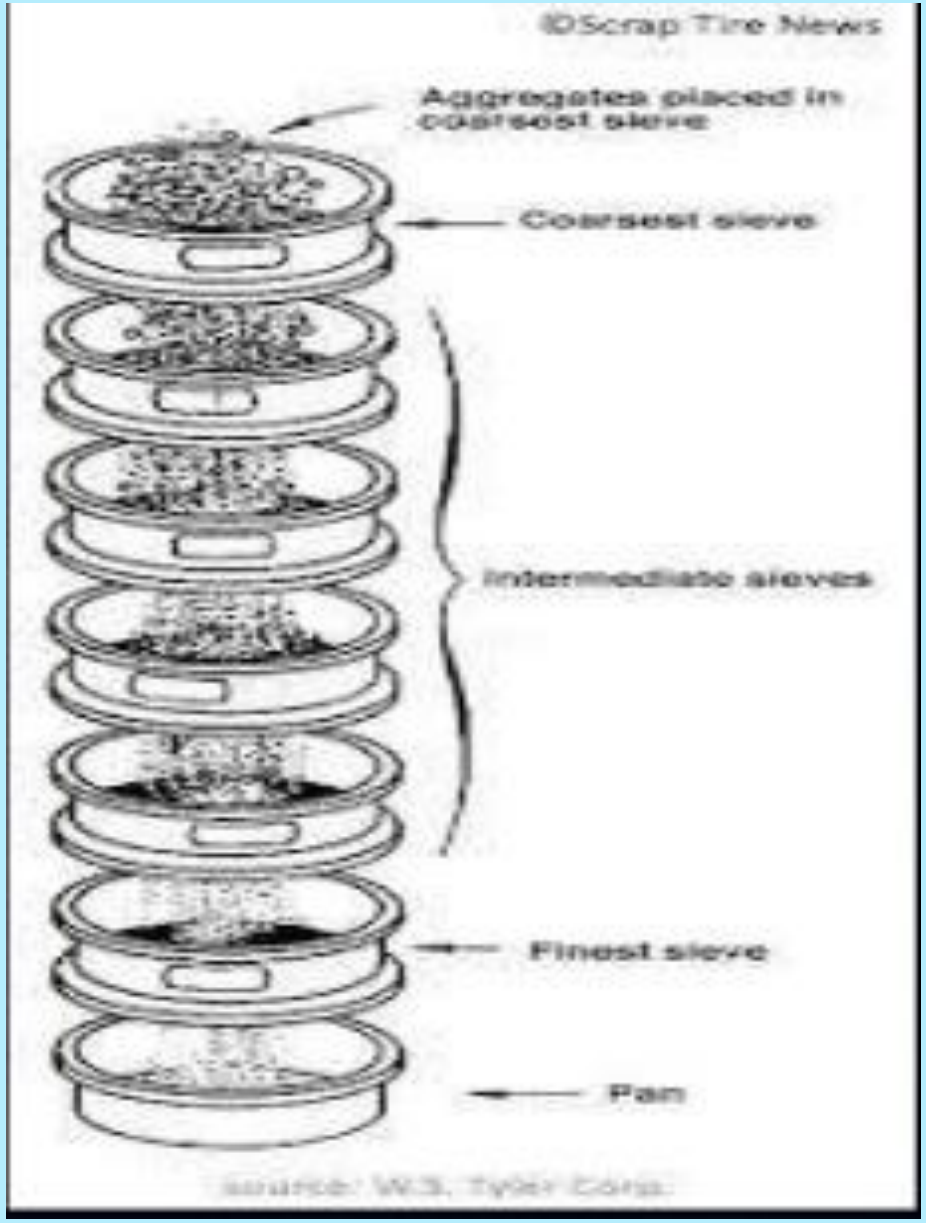
AGGREGATE CLASSIFICIATION MAP OF THE UNITED STATES



Sieve Analysis



DOT Gradation

Target Value Ranges for Subbase and Base Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)				
	Grading Designation				
	A (Subbase)	B (Subbase)	C (Base)	D (Base)	E (Base)
2½ inch	100				
2 inch	97 – 100	100	100		
1½ inch		97 – 100			
1 inch	65 – 79 (6)		80 – 100 (6)	100	
3/4 inch			64 – 94 (6)	86 – 100 (6)	100
1/2 inch	45 – 59 (7)				
3/8 inch			40 – 69 (6)	51 – 82 (6)	62 – 90 (6)
No. 4	28 – 42 (6)	40 – 60 (8)	31 – 54 (6)	36 – 64 (6)	36 – 74 (6)
No. 40	9 – 17 (4)			12 – 26 (4)	12 – 26 (4)
No. 200	4.0 – 8.0 (3)	4.0 – 12.0 (4)	4.0 –7.0 (3)	4.0 – 7.0 (3)	4.0 – 7.0 (3)

Gravel Road Gradation

Target Value Ranges for Surface Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)					
	Grading Designation					
	F	G	H	S	T	U
1 1/2 inch	100[c]			100		
1 inch	97-100	100		72 – 92 (6)	100	
3/4 inch	76-89 (6)	97 - 100	97 - 100			100
1/2 inch					71 – 91 (6)	
3/8 inch	56-68 (6)	70 – 80 (6)	80 – 92 (6)	51 – 71 (6)		71 – 90 (6)
No. 4	43-53 (7)	51 – 63 (7)	58 – 70 (7)	36 – 53 (7)	43 – 60 (7)	50 – 68 (7)
No. 8				26 – 40 (6)	30 – 46 (6)	34 – 51 (6)
No. 16	23-32 (6)	28 – 39 (6)	28 – 40 (6)			
No. 40	15-23 (5)	19 – 27 (5)	16 – 26 (5)	14 – 25 (5)	16 – 28 (5)	19 – 30 (5)
No. 200	10.0-16.0 (4)	10.0 – 16.0 (4)	9.0 – 14.0 (4)	8.0 – 15.0 (4)	8.0 – 15.0 (4)	8.0 – 15.0 (4)

Surfacing Gradation

- Well-graded
  - minimizes washboarding
  - minimizes loss of fines
  - match theoretical maximum density gradation
- Use of plastic fines

PI Test

Plasticity Index

Plasticity Index - Definition

Plasticity Index is the difference between the liquid limit and plastic limit of a soil.

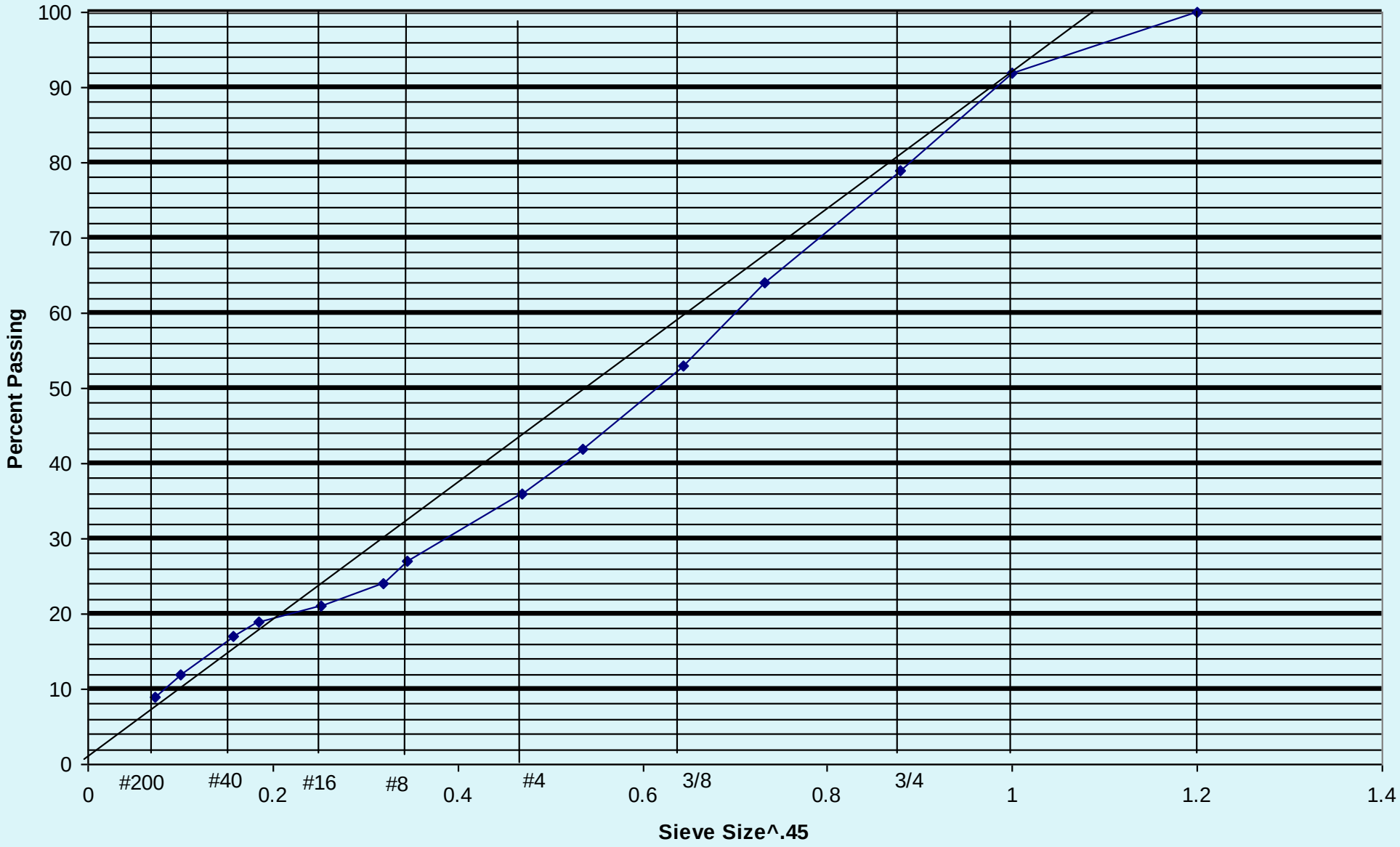
$$PI = LL - PL$$

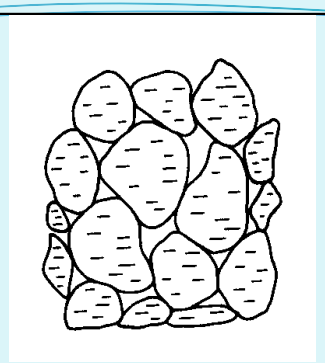
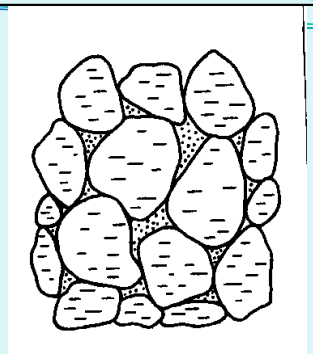
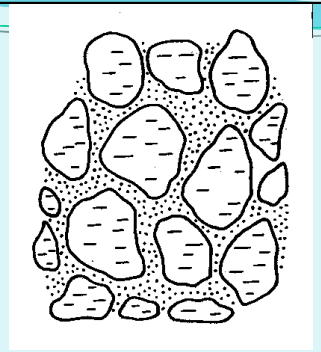
PI	Description
0	Nonplastic
1–5	Slightly plastic
5–10	Low plasticity
10–20	Medium plasticity
20–40	High plasticity
>40	Very high plasticity

Material Testing

- AASHTO T27 Graduation
  - Coarse Aggregate $72.00
  - Fine Aggregate $72.00
- P.I./ Liquid Limits $105.00
- LA Abrasion $80.00

Maxium Density Curve



		
Aggregate With No Fines	**Aggregate With Sufficient Fines For Maximum Density**	**Aggregate With Great Amount Of Fines**
Grain-to-grain contact	**Grain-to-grain contact with increased resistance against deformation**	**Grain-to-grain contact destroyed, aggregate "floating" In soil**
Variable density	**Increased to maximum density**	**Decreased density**
Pervious	**Low permeability**	**Low permeability**
Non-frost susceptible	**Frost susceptible**	**Frost susceptible**
High stability if confined, low if unconfined	**Relatively high stability In confined or unconfined conditions**	**Low stability and low strength**
Not affected by adverse water conditions	**Not greatly affected by adverse water conditions**	**Greatly affected by adverse water conditions**
Difficult to compact	**Moderately difficult to compact**	**Not difficult to compact**
Ravels easily	**Good road performance**	**Dusts easily**

Material Design

- Materials selected to optimize all weather performance
- Numerous specifications worldwide
- Performance based most useful
- Performance dependent on:
  - Particle size distribution
  - Plasticity (clay content)
  - Strength (bearing capacity)
  - Hardness
- Modification
  - Chemical
  - Mechanical

Material Design

Weighted clay factor (S_p)[1]	100 – 365
Particle size distribution factor (G_c)[2]	16 – 34
Maximum size (mm)	40 - 75
Strength factor (CBR)	>15[3]
Hardness factor (TIV)	20 – 65

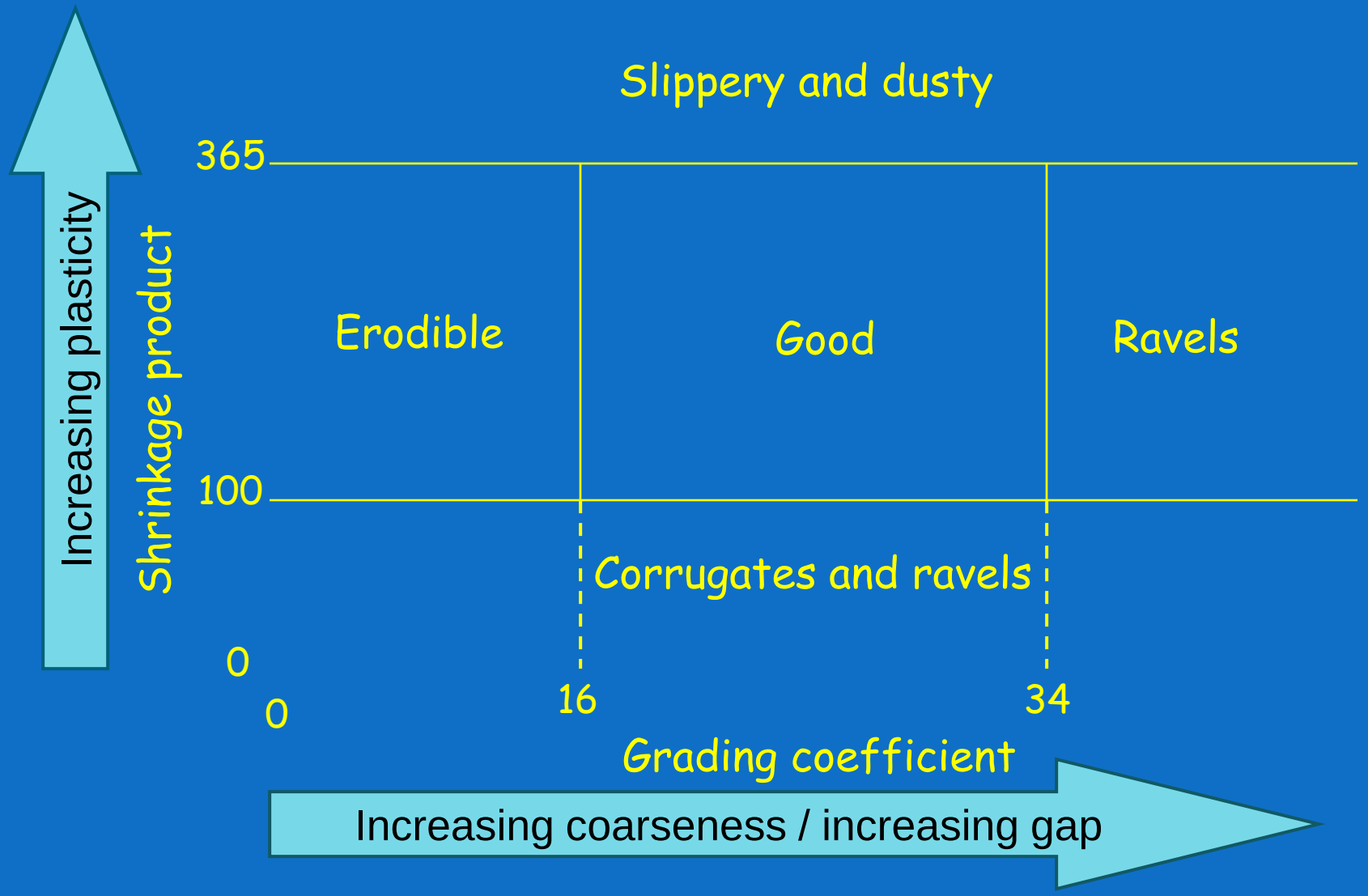
[1] BLS x %P#40 (shrinkage product)

[2] ((%P1"-%P#8) x %P#4)/100 (grading coefficient)

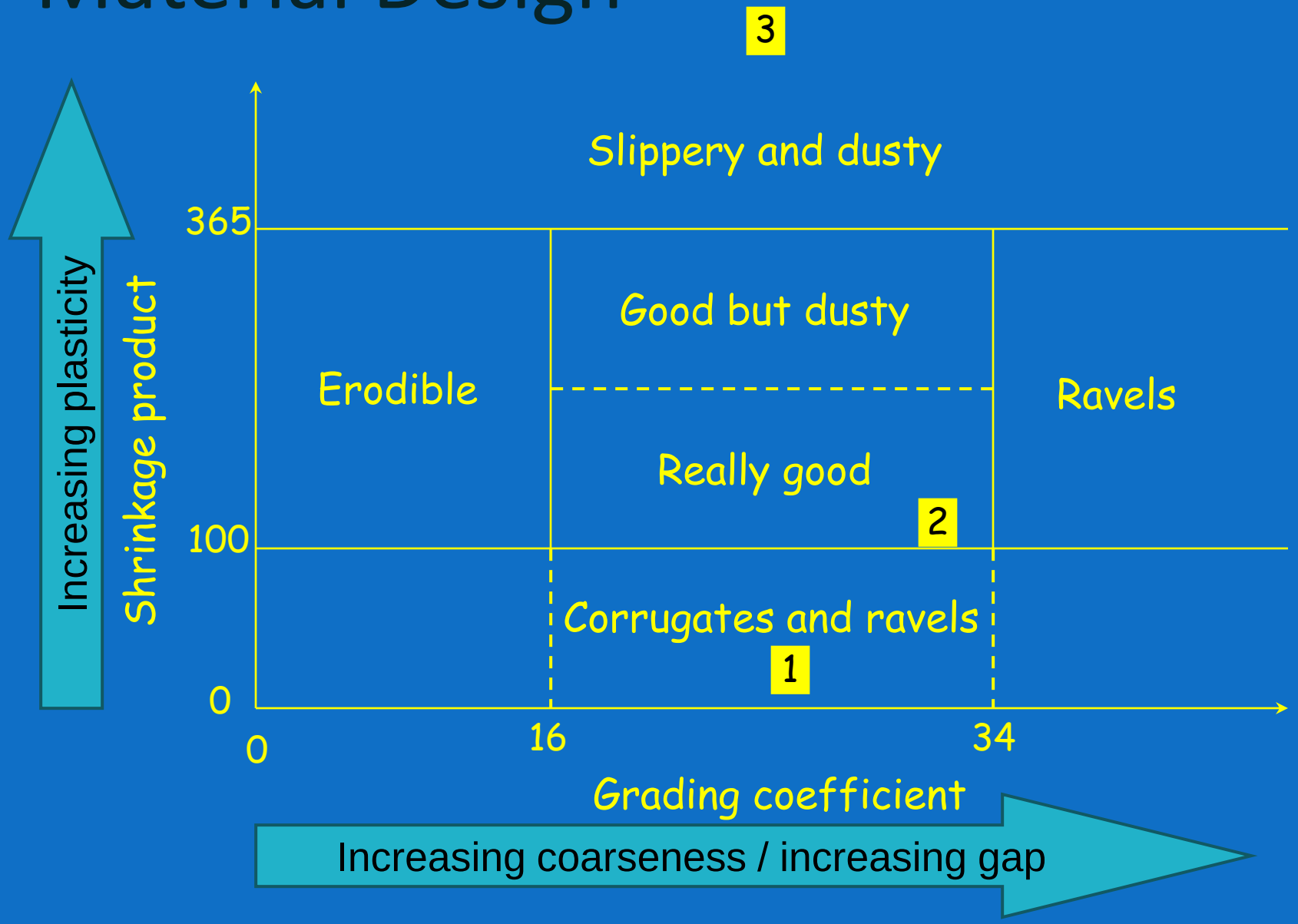
[3] Dependent on traffic

** Calibrate for local use, conditions and test methods! Performance is always dependent on construction and maintenance quality!**

Material Design



Material Design



Performance Prediction

Erosion