CHAPTER 5
GRANULAR AND TREATED BASE MATERIALS

5.1 Bases

A base course is a layer of material beneath the pavement's surface course. The design and construction of a pavement structure may include one or more base courses and is constructed on the subbase course, or, if no subbase is used, directly on the natural subgrade. It may be used in various combinations to design the most economical structural section for a specific project. Bases should be non-erodable, especially under rigid pavements, and may be constructed of gravels, mixtures of soil and aggregate, mixtures of asphalt and aggregate, mixtures of cement and aggregate or soil, or other innovative materials. Bases may be made of unbound materials, such as gravel, or bound materials, such as lime treated subgrade (17).

5.2 Sampling Base Materials During a Soil Survey Investigation

Base and subbase material samples are collected for information and testing during the soil survey investigation. The purpose of material sampling is to gather information for the design of pavement rehabilitation and/or new pavement structure. Follow the steps described in **Section 4.2 Soil Survey Investigation** for conducting soil survey investigations.

During the investigation, collect base and subbase samples for the following information and testing:

- **Thickness**
- **Gradation:** CP 21, PI and LL (AASHTO T 89 and T 90)
- **Resistance Value:** CP L 3101 and L 3102
- **Fill All Sample Holes:** provide and place patching material similar to the existing surface.
- **Combine:** similar soil and aggregate types encountered; note locations and depths.

5.3 Aggregate Base Course (ABC)

Aggregate base is normally specified as the lowest element of any structural section because it generally results in the most economical design. It may consist of more than one layer, see **Figure 5.1 Unbound Aggregate Base Course Layers**.

Aggregate base courses under flexible pavements provide a significant increase in structural capacity. Pavement design of flexible pavement depends on the wheel loads being distributed over a greater area as the depth of the pavement structure increases. Thick granular layers aim to improve the natural soil subgrade foundation of weak, fine-grained subgrades and are generally greater than 18 inches thick (16). Added benefits include improved drainage by preventing the accumulation of free water, protection against frost damage, preventing intrusion of fine-grained roadbed soils in base layers, providing a uniform underlying surface course support, and providing a construction platform.

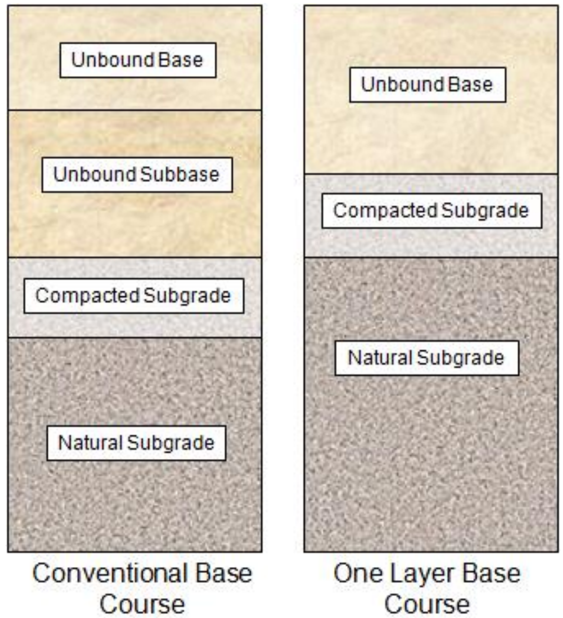


Figure 5.1 Unbound Aggregate Base Course Layers

Subbase layers are usually distinguished from the base course layers by less stringent specification requirements for strength, plasticity, and gradation. Because the subbase course must be of significantly better quality than the roadbed soil, the subbase is often omitted if roadbed soils are of high quality. When the roadbed soils are of relatively poor quality and the design procedure indicates the requirement for substantial thickness of pavement, alternate designs should be prepared for structural sections with and without a subbase. A selection may be made based on availability and relative costs for a base and subbase (20). Unbound subbase layers may be pit-run gravels comprised of rounded rock, sand, and soil mixture. Typically, sand or granular materials, or course grained materials with limited fines, corresponding to AASHTO A-1 and A-2 soils may be used. California Bearing Ratio (CBR) and/or resilient modulus testing may measure strength and stiffness of the subbase. Subbases having strengths and stiffness of CBR values 6 percent or greater, corresponding resilient moduli (M_r) of approximately 8,000 psi, R-value of 50, or structural coefficient (a_3) of 0.06 would be designated as an aggregate subbase material.

A CDOT base's M_r may range from 20,000 to 48,675 psi. Slight differences of the suggested values can be found in charts, graphs, and correlation tables of other publications. CDOT Aggregate Base Course Class 1, 2 or 3 would be classified as a subbase. Class 1 and 2 are more restrictive because of the sieve sizing than Class 3 (pit-run). Aggregate base courses Class 4 and Class 6 limit the fines from 3 to 12 percent passing the No. 200 sieve. When the gradation approaches the 12 percent passing, the base becomes impermeable, and as such, when the gradation approaches the 3 percent limit they tend to be more permeable.

Aggregate base courses under rigid pavements provide a drainage layer, protection against frost damage, uniform, stable, permanent support, and support for the heavy equipment used during rigid pavement placement, and reduce pumping. There is some increase in structural capacity when a base is placed under a rigid pavement, but typically not a significant amount (17). Bases provide uniform support of rigid pavements across the joints and under the entire slab. A non-erodable base is most desirable. To limit pumping of fines through the joints, a good base course gradation such as an Aggregate Base Course (Class 6) limits the fines from 3 to 12 percent passing the No. 200 sieve. The base course is considered a structural layer of the pavement along with the concrete slab, thus its thickness and modulus are important design values (19).

Aggregates for bases should be crushed stone, crushed slag, crushed gravel, natural gravel, or crushed reclaimed concrete or asphalt material and shall conform to the requirements of Section 703.03 of *CDOT Standard Specifications for Road and Bridge Construction* and **Table 5.1 CDOT Classification for Aggregate Base Course** and **Table 5.7 CDOT Classification** for reclaimed asphalt pavement and quality requirements of AASHTO M 147. Placement and compaction of each lift layer shall continue until a density of not less than 95 percent of the maximum density determined in accordance with AASHTO T 180 has been achieved (13). FHWA also recommends using only crushed aggregates in the unbound base layer to maintain good mechanical interlock. The design thickness should be rounded up to the next 1.0 inch increment.

Table 5.1 CDOT Classification for Aggregate Base Course

Sieve Size	Mass Percent Passing Square Mesh Sieves						
	LL Not Greater Than 35			LL Not Greater Than 30			
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
6"			100				
4" (100 mm)		100					
3" (75 mm)		95-100					
2 $^{1}/_{2}$" (60 mm)	100						
2" (50 mm)	95-100			100			
1 $^{1}/_{2}$" (37.5 mm)				90-100	100		
1" (25 mm)					95-100		100
$^{3}/_{4}$" (19 mm)				50-90		100	
#4 (4.75 mm)	30-65			30-50	30-70	30-65	
#8 (2.36 mm)						25-55	20-85
#200 (75 µm)	3-15	3-15	20 max.	3-12	3-15	3-12	5-15
NOTE: Class 3 material shall consist of bank or pit-run material.							

5.3.1 Unbound Layer Characterization in M-E Design

The unbound layer characterization in M-E Design is similar to that of subgrade characterization. The inputs required for unbound layer characterization are the resilient modulus and other physical/engineering properties such as soil classification, moisture content, dry density, saturated hydraulic conductivity, etc., and follows the same guidelines used in subgrade material characterization. **Note:** M-E Design prefers to have a minimum of <u>three</u> unbound layers for a successful design.

- New Flexible an JPCP: **Table 4.2 Recommended Subgrade Inputs in New Flexible and JPCP Designs.**
- HMA Overlays of Existing Flexible Pavement: **Table 4.3 Recommended Subgrade Inputs for HMA Overlays of Existing Flexible Pavement.**
- Overlays of Existing Rigid Pavement: **Table 4.4 Recommended Subgrade Inputs for Overlays of Existing Rigid Pavement.**

The design M_r of the aggregate base and subbase layers must be adjusted for limiting modulus criteria and modified accordingly. This check is necessary to avoid decompaction and build-up of tensile stresses in the unbound layers.

The M_r of the unbound material in each layer is a function of the layer thickness and the modulus of the next underlying layer (including subgrade layers). **Note:** The unbound materials are stress-dependent; the M_r value decreases with increasing depth as the induced stresses attenuate. Therefore, to avoid decompaction, the M_r of the aggregate base and subbase layers should not exceed the limiting modulus criteria determined using **Figure 5.2 Limiting Modulus Criteria of Unbound Aggregate Base Layers** and **Figure 5.3 Limiting Modulus Criteria of Unbound Subbase Layers**. The *AASHTO Interim MEPDG Manual of Practice* recommends the design M_r value of the unbound material be capped at the corresponding limiting modulus.

Using **Figure 5.2 Limiting Modulus Criteria of Unbound Aggregate Base Layers** and **Figure 5.3 Limiting Modulus Criteria of Unbound Subbase Layers** involves entering the graph with a known value of the modulus of the lower layer and the thickness of the next overlying layer. The figures limit the maximum values of 100,000 psi and 40,000 psi for base and subbase course materials, respectively.

<u>Example:</u> If the M_r of the underlying subgrade layer is 10,000 psi and the thickness of the overlying subbase layer is 8 inches, the M_r of the overlying layer is limited to approximately 18,500 psi.

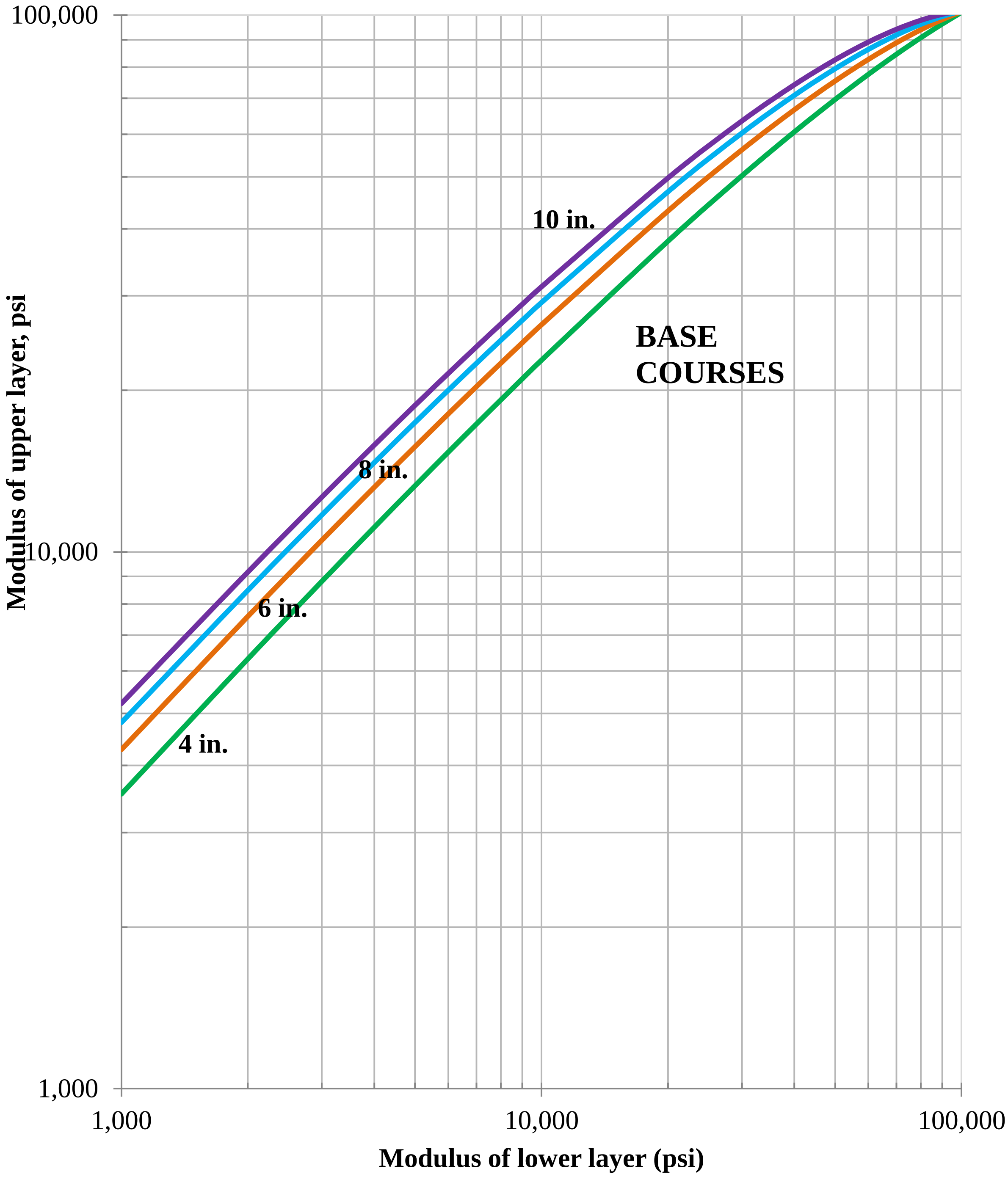


Figure 5.2 Limiting Modulus Criteria of Unbound Aggregate Base Layers

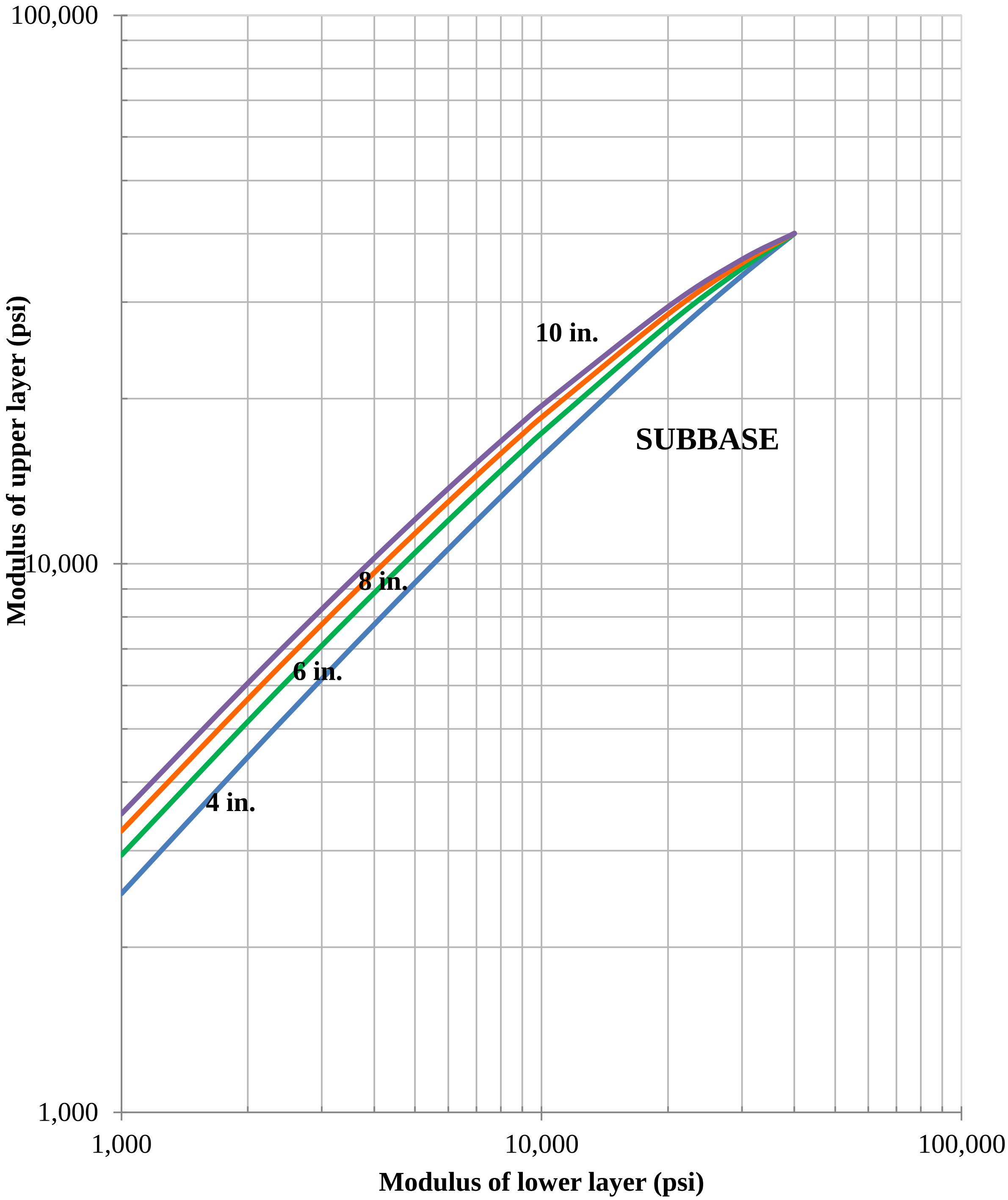


Figure 5.3 Limiting Modulus Criteria of Unbound Subbase Layers

5.3.2 Modeling Unbound Aggregate Base Layers in M-E Design Software

To properly characterize unbound layers for M-E Design, the designer should consider the following:

- **Modeling Thick Aggregate Bases**
  - When a thick granular aggregate base (more than 12 inches) is used, the top 8 or 10 inches is modeled as an aggregate base layer, while the remaining aggregate is modeled as Subgrade Layer 1. The M_r and other physical/ engineering properties remain the same for both layers. The compacted or natural subgrade below the thick aggregate base is modeled as lower subgrade layers as appropriate.
- **Modeling Thin Aggregate Bases**
  - If a thin aggregate base layer is used between two thick unbound materials, the thin layer should be combined with the weaker or lower layer.
  - When similar aggregate base and subbase materials are combined, the material properties of the combined layer should be those from the thicker layer.
    - Averaging the material properties is <u>not</u> recommended.
    - When similar materials have about the same thickness, the material with the lower modulus value should be used.
- **Limiting Modulus Criteria**
  - The designer must make sure the M_r of the unbound layer does not exceed the limiting modulus determined using **Figure 5.2 Limiting Modulus Criteria of Unbound Aggregate Base Layers** and **Figure 5.3 Limiting Modulus Criteria of Unbound Subbase Layers**.
- **Stabilized Layer**
  - Granular base materials treated with a small amount of stabilizers, such as asphalt, emulsion, cement, lime, or other pozzolanic materials for constructability reasons should be defined as an unbound layer or combined with other unbound layers, as necessary.
  - Per Applied Research Associates, Inc., since Colorado has no calibration coefficient, one <u>should not</u> use a stabilized layer. Rather the designer should treat the layer as a high quality subbase or base course with a constant modulus.

- **Soil Aggregate Materials**

    - Sand and other soil-aggregate materials should be defined separately from crushed stone or crushed aggregate base materials.

5.4 Treated Base Course

The use of bases in the design of rigid pavements is a function of the pavement material's structural quality characterized by the modulus of rupture and elastic modulus. In comparison to the strength of the concrete slab, the structural contributions of the underlying layers are relatively small. Treated or untreated bases can be used under rigid pavements, but is not mandatory. **Figure 5.4 Stabilized Treated Structural Base Layers** shows several materials historically used by CDOT as bases.

- **Treated Bases** under flexible pavements are similar to rigid pavements, as such the structural capacity is increased while decreasing the flexible pavement's thickness. These bases are used to strengthen a weak subgrade and are another design tool in the layering system where lower quality materials are in the bottom courses.

- **Plant Mix Bituminous Base (PMBB)** is composed of a mixture of aggregate, filler (if required), hydrated lime, and bituminous material. The aggregate and bituminous materials are mixed at a central batch plant. Several aggregate fractions are sized, uniformly graded, and combined in such proportions that the resulting composite blend meets the job-mix formula. PMBB is a very good non-erodable base.

- **Emulsified Asphalt Treated Base (EATB)** is composed of a mixture of aggregate, water (if required), and emulsified asphalt. The aggregate and emulsified asphalt is mixed at a central batch plant and the aggregates are specified per the classification of an aggregate base course. In certain instances subgrades may be used if they are sandy and do not have an excessive amount of material finer than the No. 200 sieve. Placement and spreading is by approved spreading devices capable of achieving specified surface tolerances and a compaction not less than 95 percent of AASHTO T 180.

- **Cement Treated Base (CTB)** is a mixture of aggregate and portland cement. The aggregate is obtained from scarifying the existing roadway and shall meet specified gradation. Mixing is accomplished by means of a mixer that will thoroughly blend the aggregate with the cement. The mixer is equipped with a metering device that will introduce the required quantity of water during the mixing cycle. Another option is to have the aggregate proportioned and mixed with cement and water at a central batch plant. Compaction is not less than 95 percent of AASHTO T 134.

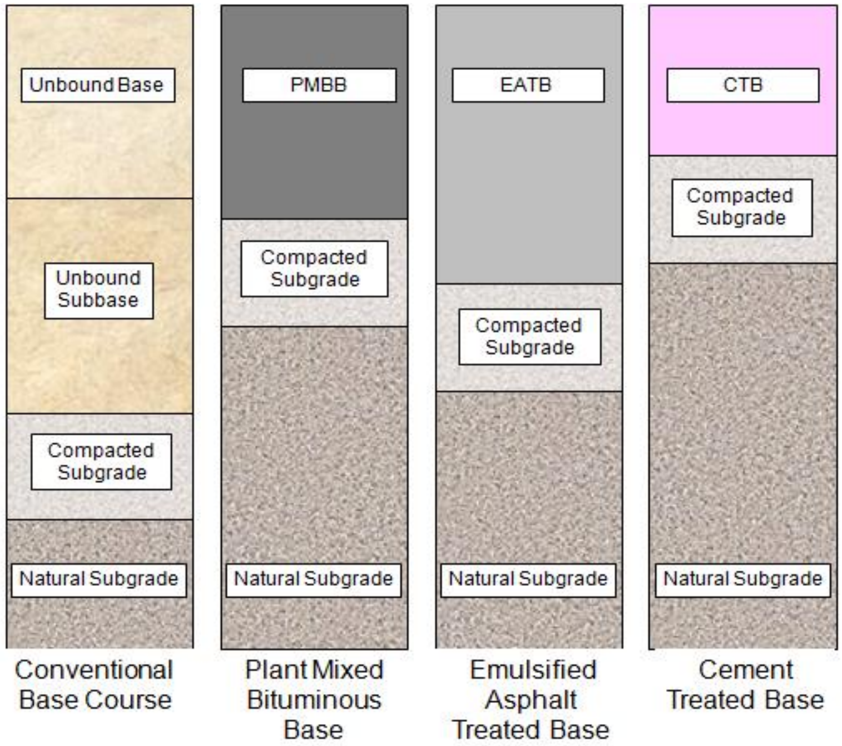


Figure 5.4 Stabilized Treated Structural Base Layers

5.4.1 Characterization of Treated Base in M-E Design

Treated base materials include lean concrete, cement stabilized, open-graded cement stabilized, soil cement, lime-cement-fly ash, and lime treated materials. Materials with chemical stabilizers engineered to provide long-term strength and durability should be considered a chemically stabilized layer (i.e. cement treated, lean concrete, pozzolonic treated). Lime and/or lime-fly ash stabilized soils engineered to provide structural support can also be considered a chemically stabilized layer. These mixtures have a sufficient amount of stabilizer mixed in with the soil, as such these types of layers are placed directly under the PCC or lowest asphalt layer. **Figure 5.5 M-E Software Screenshot for Treated Base Inputs** presents a screenshot of treated base materials. **Note:** M-E Design has a stratigraphic layer called Sandwich Granular. This layer should only be used when the designer has a layer of untreated base placed 'sandwiched' between a chemically stabilized subgrade HMA layer.

Aggregate or granular base materials lightly treated with small amounts of chemical stabilizers to enhance constructability or expedite construction (i.e. lower the plasticity index, improve the strength) should not be considered a chemically stabilized layer. Typically, lightly stabilized materials are placed deeper in the pavement structure. **Note**: Currently Colorado does not have a calibration coefficient for a stabilized layer, therefore one should treat the layer as a high quality subbase or base course with a constant modulus. The material inputs required for characterizing treated base layers in M-E Design are presented in **Table 5.2 Characterization of Treated Base in M-E Design**.

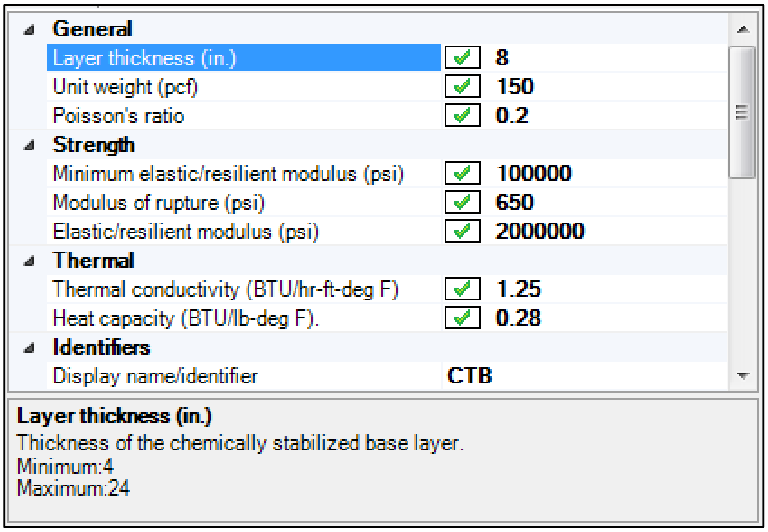


Figure 5.5 M-E Design Software Screenshot for Treated Base Inputs

Table 5.2 Characterization of Treated Bases in M-E Design

Input Property	Level 1	Level 2	Level 3
Elastic/Resilient Modulus	**Table 5.3 Level 1 Input Requirement and Corresponding Testing Protocols for Characterization of Treated Bases in M-E Design**	**Table 5.4 Level 2 Correlations for Elastic Modulus of Treated Bases**	**Table 5.6 Level 3 Default Elastic Modulus and Flexural Strength of Treated Bases**
Modulus of Rupture (flexible pavements)		**Table 5.4 Level 2 Correlations for Flexural Strength of Treated Bases**	
Minimum Elastic / Resilient Modulus (flexible pavements)	Use the following values: • Lean concrete: 300,000 psi • Cement stabilized aggregate: 100,000 psi • Open graded cement stabilized: 50,000 psi • Soil cement: 25,000 psi • Lime-cement-fly ash: 40,000 psi • Lime stabilized soils: 15,000 psi		
Poisson’s Ratio	Use typical values: • Lean concrete & cement stabilized aggregate: 0.10 to 0.20 • Soil cement: 0.15 to 0.35 • Lime-fly ash materials: 0.10 to 0.15 • Lime stabilized soil: 0.15 to 0.20		
Thermal Conductivity	Use the M-E Design software default value of 1.25 BTU/hr-ft-°F		
Heat Capacity	Use the M-E Design software default value of 0.28 BTU/lb-°F		
Total Unit Weight	Use the M-E Design software default value of 150 lb/ft^3		

Table 5.3 Level 1 Input Requirement and Corresponding Testing Protocols for Characterization of Treated Bases in M-E Design

Design Type	Material Type	Measured Property	Source of Data		Recommended Test Protocol and Data Source
			Test	Estimate	
New	Lean Concrete & Cement-Treated Aggregate	Elastic modulus	✓		ASTM C 469
		Flexural strength	✓		AASHTO T 97
	Lime-cement-fly Ash	Resilient modulus		✓	No test protocols available. Estimate using Levels 2 and 3
	Soil Cement	Resilient modulus	✓		Mixture Design and Testing Protocol (MDTP) in conjunction with AASHTO T 307
	Lime Stabilized Soil	Resilient modulus		✓	No test protocols available. Estimate using Levels 2 and 3
Existing	Lean Concrete & Cement-Treated Aggregate	FWD backcalculated modulus	✓		ASTM D4694
	Lime-Cement-Fly Ash				
	Soil Cement				
	Lime Stabilized Soil				

Table 5.4 Level 2 Correlations for Elastic Modulus of Treated Bases

Material Type	Recommended Correlations
Lean Concrete[1] Cement Treated Aggregate[1]	$E = 57{,}000 \times \sqrt{f'_c}$ f'_c = compressive strength, psi (AASHTO T 22) (18)
Open Graded Cement Stabilized	No correlations are available
Soil Cement[2]	$E = 1200 \times q_U$ q_u = unconfined compressive strength, psi (ASTM D 1633) (18)
Lime-Cement-Fly Ash[2]	$E = 500 + q_U$ q_u = unconfined compressive strength, psi (ASTM C 593) (19)
Lime Stabilized Soils[2]	$M_r = 0.124 \times q_u + 9.98$ q_u = unconfined compressive strength, psi. (ASTM D 5102) (17)

Note: E is the modulus of elasticity in psi and M_r = resilient modulus in ksi.
[1] Compressive strength f_c can be determined using AASHTO T22.
[2] Unconfined compressive strength q_u can be determined using the MDTP.

Table 5.5 Level 2 Correlations for Flexural Strength of Treated Base

Material Type	Test Protocol	Typical M_r (psi)
Lean Concrete	AASHTO T 22	$M_r \approx 20\%$ of q_u (conservative estimate)
Cement Treated Aggregate		
Soil Cement	ASTM D 1633	
Lime-Cement-Fly Ash	ASTM C 593	
Lime Stabilized Soils	ASTM D 5102	
Open Graded Cement Stabilized Aggregate	Not available	Not available
Note: q_u = unconfined compressive strength		

Table 5.6 Level 3 Default Elastic Modulus and Flexural Strength of Treated Bases

Material Type	E or M_r Range (psi)	E or M_r Typical (psi)	Flexural Strength (psi)
Lean Concrete	1,500,000 to 2,500,000	2,000,000	450
Cement Stabilized Aggregate	700,000 to 1,500,000	1,000,000	200
Soil Cement	50,000 to 1,000,000	500,000	100
Lime-Cement-Fly Ash	500,000 to 2,000,000	1,500,000	150
Lime Stabilized Soils[1]	30,000 to 60,000	45,000	25
Open Graded Cement Stabilized Aggregate	—	750,000	200
Note: [1] For reactive soils within 25 percent passing No. 200 sieve and plasticity index of at least 10.			

5.4.2 Modeling Treated Base in M-E Design

To properly model a treated base or a stabilized subgrade in M-E Design, the designer should consider the following:

- **Plant Mix Bituminous Base:** This layer is produced at a central batch plant in a similar manner conventional asphalt mixtures are produced and should be considered either as or combined with a HMA base layer.

- **Emulsified Asphalt Treated Base:** This layer is composed of crushed stone base materials and emulsified asphalt. It should be combined with the crushed stone base materials or considered as an unbound aggregate mixture.

- **Cement Treated Base:** Cement treated and other pozzolanic stabilized materials that are engineered to provide structural support should be treated as a separate layer. Where a small portion of cement and/or other pozzolanic materials are added to granular base materials for constructability issues, such layers should be considered as an unbound material and combined with those unbound layers if necessary.

- **Lime and/or Lime-Fly Ash Stabilized Soils:** These soils may be considered a stabilized material if the layer is engineered to provide structural support; otherwise, they could be considered an unbound layer that is insensitive to moisture and the resilient modulus (stiffness) of the layer can be held constant over time.

5.5 Permeable Bases

Open-graded aggregate bases are becoming popular. Permeable bases may be unstabilized or stabilized and should be placed in a layer at least 4 inches thick. Care must be taken when designing with permeable bases as they are subject to freeze-thaw cycles.

- **Unstabilized** permeable bases contain smaller size aggregates to provide interlock, however this creates a lower permeability. Typically, the coefficient of permeability is 1,000 to 3,000 feet/day. Unstabilized bases are difficult to compact and density is difficult to measure. CDOT does not recommend using an unstabilized permeable base.

- **Stabilized** permeable bases are open-graded aggregates that have been stabilized with asphalt or portland cement. Stabilization of the base does not appreciably affect the permeability of the material and provides a very stable base during the construction phase. The coefficient of permeability is greater than 3,000 feet/day. Stabilized bases provide a stable working platform for construction equipment.

- **Asphalt** stabilized permeable bases contain 2 to 2.5 percent asphalt by weight. Care must be used in construction to prevent over rolling which can lead to degradation of the aggregate and loss of permeability. The base should be laid at a temperature of 200°F to 250°F and compacted between 100°F and 150°F.

- **Cement** stabilized bases have 2 to 3 bags of portland cement/cubic yard. This provides a very strong base that is easily compacted with a vibratory screed and plate. Curing can occur by covering the base with polyethylene sheeting for 3 to 5 days or with a fine water mist sprayed several times the day after the base is placed.

The designer is suggested to use FHWA's DRIP 2.0 software. The software has capabilities to perform roadway geometry calculations for the drainage path, sieve analysis calculations, inflow calculations, permeable base design, separator design (geotextile or aggregate layer), and edgedrain design (see **Figure 5.6 Structural Permeable aggregate Base Course Layers)**. The software may be obtained from the website: http://www.fhwa.dot.gov/pavement/desi.cfm.

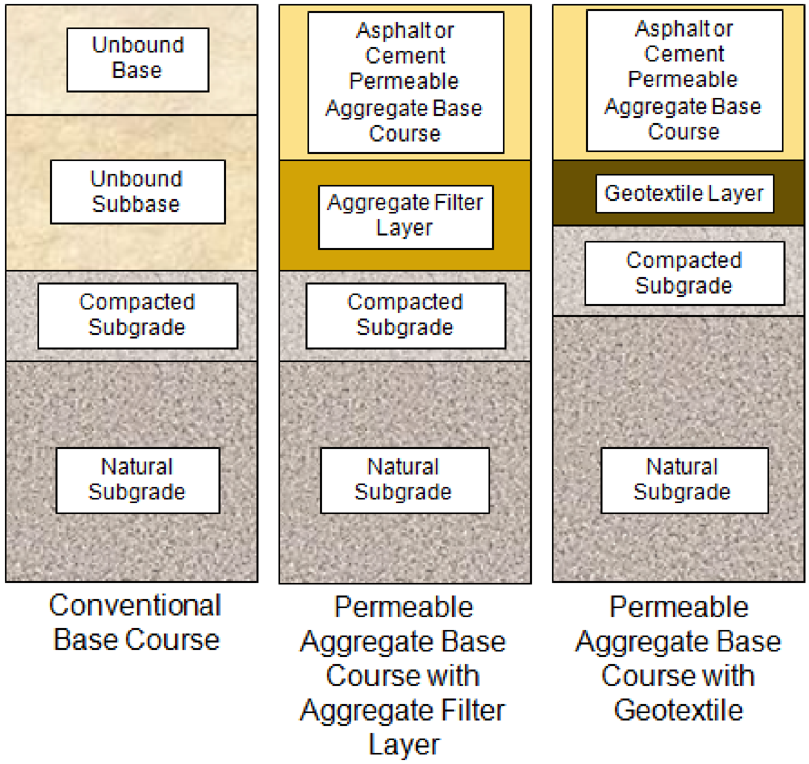


Figure 5.6 Structural Permeable Aggregate Base Course Layers

Drainage is particularly important where heavy flows of water are encountered (i.e., springs or seeps), where detrimental frost conditions are present, or where soils are particularly susceptible to expansion with increase in water content. Special subsurface drainage may include provisions of a permeable material beneath the pavement for interception and collection of water, and/or pipe drains for collection and transmission of water. Special surface drainage may require facilities like dikes, paved ditches, and catch basins (20).

5.6 Reclaimed Asphalt and Concrete Pavement

Refer to **Figure 5.7 Reclaimed Asphalt and Concrete Pavement Base Layers** for using reclaimed asphalt or concrete for a base layer.

5.6.1 Reclaimed Asphalt Pavement Base

Recycled asphalt pavement may be used as a granular base or subbase provided it meets gradation and minimum R-values specified in contract documents. Recycled asphalt used as an aggregate base is discussed in this section as a cold recycling process compared to a hot process. The cold recycling process of asphalt consists of recovered, crushed, screened, and blended material with conventional aggregates, and is placed as a conventional granular material.

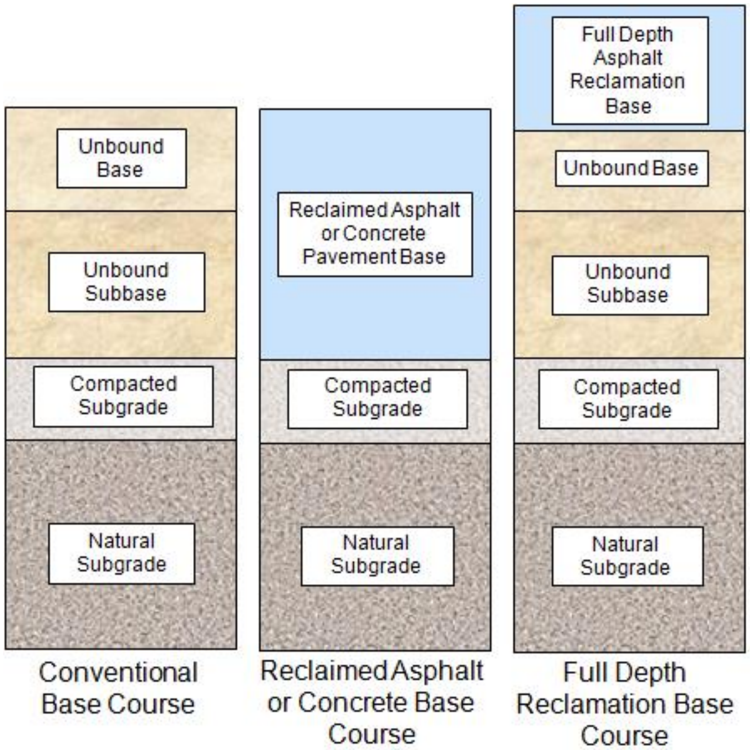


Figure 5.7 Reclaimed Asphalt and Concrete Pavement Base Layers

5.6.1.1 Reclaimed Asphalt Pavement (RAP) Base

Aggregate for Reclaimed Asphalt Pavement (RAP) base shall meet the grading requirements of **Table 5.7 CDOT Classification for Reclaimed Asphalt Program**. The aggregate shall have a liquid limit of non-viscous (NV), plasticity index of non-plastic (NP), and a Los Angeles percentage of wear of 45 or less. Placement and compaction of each lift layer shall continue until a density of at least 100 percent on the maximum wet density as determined in accordance with Colorado Procedure CP-53 has been achieved (13), see **Figure 5.8 Photos of Reclaimed Asphalt Pavement Base.**

Source: http://www.pavementinteractive.org and http://www.wjgraves.com

Figure 5.8 Photos of Reclaimed Asphalt Pavement Base

5.6.1.2 Full Depth Asphalt Reclaimed Base (FDR)

A full depth asphalt reclaimed base is an in-place process that pulverizes the existing pavement and thoroughly mixes the individual surface and granular base course layers into a relatively homogeneous mixture. It is then recompacted as a granular base (25), see **Figure 5.9 Photos of Full Depth Asphalt Reclaimed Base**. Stabilizing agents may be added with a laboratory mix design to optimize the quantity of stabilizing agent and other properties of the reclaim mix. Pavement distresses that can be treated by full depth asphalt reclamation are as follows (28):

- Cracking from age, fatigue, slippage, edge, block, longitudinal, reflection, and discontinuity.
- Reduced ride quality due to swell, bumps, sags, and depressions, which are not contributed to swelling soils.
- Permanent deformations in the form of rutting, corrugation, and shoving
- Loss of bonding between layers and stripping
- Loss of surface integrity due to raveling, potholes, and bleeding
- Inadequate structural capacity

Table 5.7 DOT Classification for Reclaimed Asphalt Pavement Aggregate Base Course

Sieve Size	Mass Percent Passing Square Mesh Sieves	
	ABC (RAP)	
	Lower Limit	Upper Limit
2" (50 mm)	100	-
1 1/2" (37.5 mm)	-	-
1" (25 mm)	85	100
3/4" (19 mm)	75	100
1/2" (12.5 mm)	55	90
3/8" (9.5 mm)	45	80
#4 (4.75 mm)	25	55
#8 (2.36 mm)	-	-
#16 (1.18 mm)	5	25
#30 (600 µm)	-	-
#50 (300 µm)	-	-
#100 (150 µm)	-	-
#200 (75 µm)	0	5

Source: http://west-cansealcoating.com and http://www.rocksolidstabilization.com

Figure 5.9 Photos of Full Depth Asphalt Reclaimed Base

5.6.2 Reclaimed Concrete Pavement Base (RCP)

Reclaimed Concrete Pavement (RCP) may be used as a granular base or subbase, similar to recycled asphalt. RCP is the recycling of recovered, crushed, and screened concrete pavement that is placed as a conventional granular material. RCP shall meet all conventional granular material requirements and have all steel removed in the recovering process.

5.7 Base Layer Made of Rubblized Rigid Pavement

Rubblization is a fracturing of existing rigid pavement creating a high-density granular material. The rough, hard particles provide an internal friction to resist rutting while the lack of tension prevents cracking in the surface layer. The reasoning for this is the more concrete available for expansion and contraction during temperature changes, the greater the movement of the slab, thus, the greater the opening of joints and cracks. Rubblization reduces the size of concrete pieces so the expansion and contraction has minimum movement. The space between the fractured pieces moves less so cracks are not reflected through the surface course. An edge drain system needs to be installed to remove water captured between the fractured concrete slabs. The fractured concrete pavement has been found to be more permeable than a dense graded compacted base layer (see **Figure 5.10 Rubblized Base Course** and **Figure 5.11 Photo of Rigid Pavement Being Rubblized**).

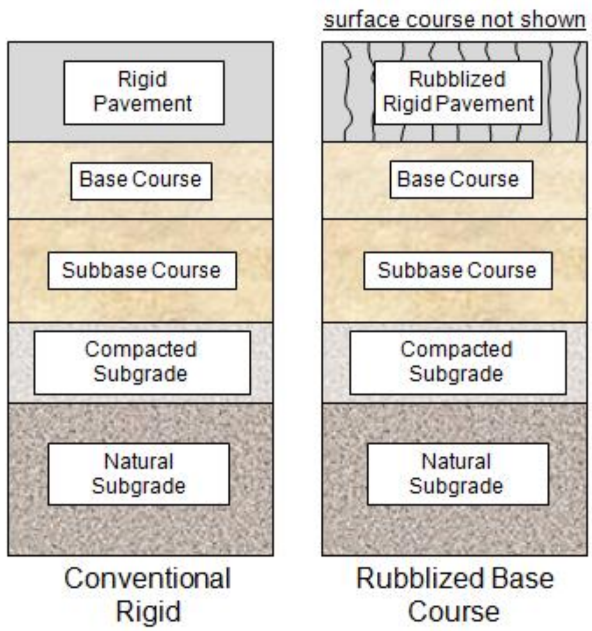
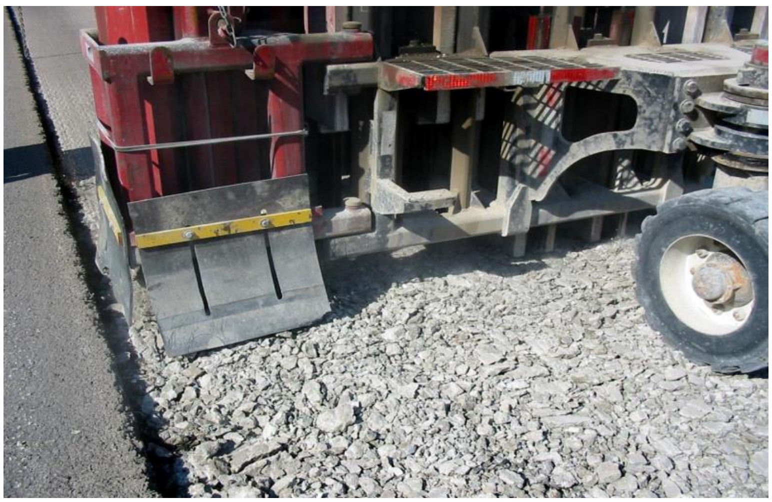


Figure 5.10 Rubblized Base Course



Source: http://www.antigoconstruction.com

Figure 5.11 Photo of Rigid Pavement Being Rubblized

5.8 Material Sampling and Testing

Sampling involves coring the existing pavement to determine layer thicknesses, make a visual inspection of the subsurface condition, and obtain material samples of unbound layers for further testing. For an existing pavement, the types of tests performed on the extracted materials should depend on the type of distress observed. Contact the Region Materials Engineer and see Chapter 200 of the *Field Materials Manual* for information on recommended sampling intervals and further guidance on available material test methods.

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