



SECTION 33 – ECONOCRETE BASE COURSE (FAA P-306)

33-1 GENERAL

The Contractor shall perform all work required by the plans and specifications for construction of a subbase material, herein termed econocrete, that is composed of aggregate and cement uniformly blended together and mixed with water. The mixture may also include approved cementitious additives, in the form of fly ash or slag, and chemical admixtures. The mixed material shall be spread, shaped, and consolidated using concrete paving equipment in accordance with these specifications and in conformity to the lines, grades, dimensions, and typical cross-sections shown on the plans.

The proper performance of Econocrete Base Course requires that the compressive strength of the Econocrete be limited between a low and a high compressive strength value. There will therefore be penalties for producing material that is either too weak or too strong. If strength exceeds the values indicated in this specification, the Contractor will be required to sawcut stress relief grooves to ensure proper performance of the Portland Cement Concrete pavement to be placed over the Econocrete. These sawcuts must match the location of the planned joints for the PCC pavement. If the specified Econocrete strength is exceeded, and the Contractor does not cut the stress relief grooves, he will be required to remove and replace the econocrete at his own expense. Payment will be not made for sawcutting, but it will be considered the sole responsibility of the Contractor for failing to adhere to the upper strength requirements of this Specification. If strength does not meet the minimum value indicated, the Econocrete will be removed and replaced at the Contractor's expense.

The Contractor will be allowed to use recycled aggregate for production of econocrete if the requirements of this section are met, including amelioration for excessive strength econocrete (saw cutting) is done.

ITEM P-306 ECONOCRETE BASE COURSE

DESCRIPTION

306-1.1 This item shall consist of a subbase material, herein termed econocrete, that is composed of aggregate and cement uniformly blended together and mixed with water. The mixture may also include approved cementitious additives, in the form of fly ash or slag, and chemical admixtures. The mixed material shall be spread, shaped, and consolidated using concrete paving equipment in accordance with these specifications and in conformity to the lines, grades, dimensions, and typical cross-sections shown on the plans.

MATERIALS

306-2.1 AGGREGATE. The coarse aggregate fraction shall be crushed stone, crushed or uncrushed gravel, crushed and adequately seasoned, air-cooled, iron



blast furnace slag, crushed recycled concrete, or a combination thereof. The fine aggregate fraction may be part of the natural aggregate blend as obtained from the borrow source or it may be natural sand that is added at the time of mixing.

The aggregate shall consist of hard, durable particles, free from an excess of flat, elongated, soft, or disintegrated pieces, or objectionable matter (e.g., roots, sod, weeds, organic impurities, etc.). A flat particle is one having a ratio of width to thickness greater than five; an elongated particle is one having a ratio of length to width greater than five.

Table 1. Aggregate – Econocrete Base Course	
<i>Sieve Size (square openings)</i>	<i>Percentage by Weight Passing Sieves</i>
<i>2 inches</i>	<i>100</i>
<i>1 inch</i>	<i>55 - 85</i>
<i>3/4 inch</i>	<i>50 - 80</i>
<i>No. 4</i>	<i>30 - 60</i>
<i>No. 40</i>	<i>10 - 30</i>
<i>No. 200</i>	<i>0 - 15</i>

Recycled aggregate may be used for econocrete aggregate if it meets the grading requirements of this section. Cement liberated from the crushing of concrete pavement for such recycling will have an unknown strength gain effect on the econocrete, however, and it is extremely likely that the Contractor will be required to do stress relief saw-cutting of the econocrete produced with this material. No separate payment will be made for such saw cutting which will be considered an incidental cost and shall be included in the price bid for econocrete.

306-2.2 CEMENT. *Cement shall conform to the requirements of ASTM C 150, Type II.*

306-2.3 CEMENTITIOUS ADDITIVES. *Pozzolanic and ground granulated blast furnace (GGBF) slag may be added to the econocrete mix. If used, each material must meet the following requirements:*

- a. Pozzolan. Pozzolan materials must meet the requirements of ASTM C 618, Class F Flyash.*
- b. Ground Granulated Blast Furnace Slag (Slag Cement). Slag shall conform to ASTM C 989, Grade 80, 100 or 120.*



306-2.4 CHEMICAL ADMIXTURES. *The Contractor shall submit certificates indicating that the material to be furnished meets all the requirements listed below. In addition, the Engineer may require the Contractor to submit complete test data showing that the material to be furnished meets all the requirements of the cited specification.*

- a. *Air-Entraining Admixtures. Air-entraining admixtures shall meet the requirements of ASTM C 260.*
- b. *Water-Reducing Admixtures. Water-reducing, set-controlling admixtures shall meet the requirements of ASTM C 494, Type A, water-reducing or Type D, water-reducing and retarding. Water-reducing admixtures shall be added at the mixer separately from air-entraining admixtures in accordance with the manufacturer's printed instructions. The air entrainment agent and the water-reducing admixture shall be compatible.*

306-2.5 WATER. *Water used in mixing or curing shall be clean and free of oil, salt, acid, alkali, sugar, vegetable, or other deleterious substances injurious to the finished product. Water will be tested in accordance with the requirements of AASHTO T 26. Water known to be of potable quality may be used without testing.*

306-2.6 CURING MATERIALS. *For curing econocrete, use white-pigmented, liquid membrane-forming compound conforming to ASTM C 309, Type 2, Class A or Class B (wax-based) or Asphalt emulsion conforming to the requirements of ASTM D 977, Type SS-1h.*

COMPOSITION OF MIXTURE

306-3.1 MIX DESIGN. *The econocrete mix design shall be based on trial batch results conducted in the laboratory. The econocrete shall be designed to meet the criteria in this section.*

306-3.1.1 Compressive Strength. *Compressive strength shall not be less than 500 psi nor greater than 750 psi at 7 days. Compressive strength at 28-days shall not exceed 1,000 psi. All compressive strength specimens shall be prepared and tested in accordance with ASTM C 192 and ASTM C 39, respectively.*

If the 3-day strength is greater than 500 psi, the Contractor shall construct transverse joints in the econocrete layer in accordance with paragraph 306-5.10.2.

If there is a change in aggregate sources, type of cement used, or pozzolanic materials, a new mix design must be submitted.



306-3.1.2 Air Content. *The percentage of air entrainment shall be 6 percent, plus or minus 1/2 percent. Air content shall be determined by testing in accordance with ASTM C 231 for gravel and stone coarse aggregate and ASTM C 173 for slag and other highly porous coarse aggregate.*

306-3.2 SUBMITTALS. *At least 15 days prior to the placement of the econocrete, the Contractor shall submit certified test reports to the Engineer for those materials proposed for use during construction, as well as the mix design information for the econocrete material. Tests older than 6 months shall not be used. The certification shall show the appropriate ASTM or AASHTO specifications or tests for the material, the name of the company performing the tests, the date of the tests, the test results, and a statement that the material did or did not comply with the applicable specifications. The submittal package shall include the following:*

- a. *Sources of materials, including aggregate, cement, admixtures, and curing and bond breaking materials.*
- b. *Physical properties of the aggregates, cement, admixtures, curing and bond breaking materials.*
- c. *Mix design.*
 - *mix identification number.*
 - *weight of saturated surface-dry aggregates (fine and coarse).*
 - *combined aggregate gradation.*
 - *cement factor.*
 - *water content.*
 - *water-cementitious material ratio (by weight).*
 - *volume of admixtures and yield for one cubic yard (cubic meter) of econocrete.*
- d. *Laboratory test results.*
 - *slump.*
 - *air content.*
 - *compressive strength at 3, 7, and 28 days (average values).*
 - *wet/dry and/or freeze-thaw weight loss (when applicable).*

In addition, where applicable, the Contractor shall submit for approval by the Engineer a jointing plan for transverse joints in the econocrete layer.

During production, the Contractor shall submit batch tickets for each delivered load.

EQUIPMENT



306-4.1 All equipment necessary to mix, transport, place, compact, and finish the econocrete material shall be furnished by the Contractor. The equipment shall be subject to inspection and approval by the Engineer.

306-4.2. MIXING.

306-4.2.1 Econocrete may be mixed in a stationary mixer, either at a central batch plant or at the site, or in a truck mixer. The mixer type and capacity shall be inspected and approved by the Engineer before production begins. Each mixer shall have attached in a prominent place a manufacturer's nameplate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

306-4.2.1 Stationary Plant Mixer. The batch plant and equipment shall conform to the requirements of ASTM C 94. Unrestricted access to the plant must be provided to the Engineer at all times for inspection of the plant's equipment and operation and for sampling the econocrete mixture and its components.

The mixers shall be examined daily for changes in condition due to accumulation of hard concrete or mortar or wear of blades.

306-4.2.2 Truck Mixers. Truck mixers used for mixing econocrete shall conform to the requirements of ASTM C 94. Econocrete may be entirely mixed in a truck mixer or partially mixed in a stationary mixer with mixing completed in a truck mixer. Truck mixers shall be equipped with an accurate continuous registering electronically or mechanically activated revolution counter, by which the number of drum revolutions may be verified.

306-4.3 HAULING. Mixed econocrete shall be hauled from the stationary plant to the job site in a truck agitator, a truck mixer operating at agitating speed, or a non-agitating truck. All equipment shall conform to the requirements of ASTM C 94. When truck mixers are used to mix econocrete, they may be transported to the job site in the same truck operating at agitating speeds, truck agitators, or a non-agitating truck. The bodies of non-agitating trucks shall be smooth, metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation.

306-4.4 PLACING AND FINISHING.

306-4.4.1 Forms. Straight side forms shall be made of steel and shall be furnished in sections not less than 10 ft in length. Forms shall have a depth equal to the pavement thickness at the edge. Flexible or curved forms of proper radius shall be used for curves of 100-ft radius or less. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating



and finishing equipment. Forms with battered top surfaces and bent, twisted or broken forms shall not be used. Built-up forms shall not be used, except as approved by the Engineer.

The top face of the form shall not vary from a true plane more than $\frac{1}{8}$ inch in 10 ft, and the upstanding leg shall not vary more than $\frac{1}{4}$ in. The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting. Wood forms may be used under special conditions, when accepted by the Engineer.

306-4.4.2 Pavers. Econocrete can be placed using fixed forms or slip-form pavers. The paver shall be fully energized, self-propelled and capable of spreading, consolidating, and finishing the econocrete material, true to grade, tolerances, and cross sections. The paver shall be capable of finishing the surface so that hand finishing is not required. The paver shall be of sufficient weight and power to construct the maximum specified concrete paving lane width, at adequate forward speed, without transverse, longitudinal or vertical instability or without displacement. The slip-form paver shall be equipped with electronic or hydraulic horizontal and vertical control devices utilizing guide wires or stringlines on both sides of the machine. Slope control will not be allowed.

- a. **Concrete Pavers.** Concrete pavers are approved as paver-finishing machines for econocrete, providing they are capable of handling the amount of econocrete required for the full-lane width specified, and consolidating the econocrete full depth. A concrete paver is a power-driven machine with augers, strike-off and tamper bars ahead of a pan screed, with at least one trailing oscillating screed or belt finisher.
- b. **Bridge Deck Pavers.** Bridge deck pavers are approved as paver-finishing machines for econocrete, providing they are capable of handling the amount of econocrete required for the full-lane width specified, and consolidating the econocrete full depth. A bridge deck paver is an automatic truss paving machine, with paving carriage that strikes off, vibrates, paves, and textures the econocrete with augers, internal vibration, paving rollers, and drag pan.

306-4.5 CONSOLIDATION. For side-form construction, vibrators may be either the surface pan type for pavements less than 8 in thick or the internal type with either immersed tube or multiple spuds for the full width of the slab. They may be attached to the spreader or the finishing machine, or they may be mounted on a separate carriage. They shall not come in contact with the joint, subgrade, or side forms.



For slip-form construction, the paver shall vibrate the econocrete for the full width and depth of the strip of pavement being placed. Vibration shall be accomplished by internal vibrators.

The number, spacing, frequency, and eccentric weights of vibrators shall be provided as necessary to achieve acceptable consolidation without segregation and finishing quality. Adequate power to operate all vibrators at the weight and frequency required for a satisfactory finish shall be available on the paver. The internal vibrators may be supplemented by vibrating screeds operating on the surface of the econocrete. The Contractor shall constantly monitor the frequency of each of the individual vibrators using electronic means and shall provide constant monitoring of the consolidation process to avoid honeycombing or segregation. Areas that are visually determined to be honeycombed or over-consolidated shall be corrected at the Contractor's expense.

The vibrators and tamping elements shall be automatically controlled so that they stop operation as forward motion ceases. Any override switch shall be of the spring-loaded, momentary-contact type.

Hand held vibrators may be used in irregular areas.

306-4.6 JOINTING. *The Contractor shall provide sawing equipment adequate in number of units and power to produce contraction or construction joints of the required dimensions as shown on the plans. The Contractor shall provide at least one standby saw in good working order and a supply of saw blades at the site of the work at all times during sawing operations.*

CONSTRUCTION METHODS

306-5.1 WEATHER LIMITATIONS.

306-5.1.1 Cold Weather. *Unless authorized by the Engineer, the temperature of the mixed econocrete shall not be less than 50°F (10°C) at the time of placement. In addition, the econocrete shall not be placed when the ambient temperature is below 40°F (4°C) or when conditions indicate that the temperature may fall below 35°F (2°C) within 24 hours. Under no circumstances shall the econocrete be placed on frozen underlying courses or mixed when the aggregate is frozen.*

When mixing and placing is authorized during cold weather, the Engineer may require the water and/or the aggregates to be heated to not less than 70°F (20°C) nor more than 150°F (66°C). The aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might be detrimental to the materials.



306-5.1.2 Hot Weather. To prevent rapid drying of newly constructed econocrete, the econocrete temperature from initial mixing through final cure shall not exceed 90°F (32°C). The aggregates and/or mixing water shall be cooled as necessary to maintain the econocrete temperature at or not more than the specified maximum. Ice or ice water may be substituted for the mixing water for this purpose.

In addition, during periods of warm weather when the maximum daily air temperature exceeds 85°F (30°C), the forms and/or the underlying material shall be sprinkled with water immediately before placing the econocrete.

306-5.1.3 Rain. All mixing and batching operations should be halted during rain showers and any plastic econocrete placed should be covered immediately. The econocrete shall be kept covered with plastic sheeting or other waterproof material until such time that the rain does not make any surface indentation on the econocrete layer. Areas damaged by rain shall be refinished or replaced.

306-5.2 FORM SETTING. Forms shall be set sufficiently in advance of the econocrete placement to ensure continuous paving operation. After the forms have been set to correct grade, the grade shall be thoroughly tamped, either mechanically or by hand, at both the inside and outside edges of the base of the forms. Forms shall be staked into place with not less than 3 pins for each 10-ft section. A pin shall be placed at each side of every joint.

Form sections shall be tightly locked and shall be free from play or movement in any direction. The forms shall not deviate from true line by more than 1/4 in at any joint. Forms shall be so set that they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms shall be cleaned and oiled prior to the placing of econocrete.

The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the econocrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

306-5.3 PREPARATION OF UNDERLYING COURSE. The underlying course shall be checked by the Engineer before placing and spreading operations are started, in order to ensure that it is free of any ruts, depressions, or bumps and is finished to the correct grade. Any ruts or soft yielding places in the underlying course caused by improper drainage conditions, hauling, or any other cause, shall be corrected at the Contractor's expense before the econocrete mixture is placed thereon. The underlying course should be wetted down in advance of placing the econocrete to ensure a firm, moist condition at the time of econocrete placement. The underlying course shall be protected from frost. Usage of chemicals to eliminate frost is not permissible.



306-5.4 GRADE CONTROL. *Grade control between the edges of the pavement shall be accomplished at intervals of 50 ft or less on the longitudinal grade and at 25 ft or less on the transverse grade. To protect the underlying course and ensure proper drainage, the econocrete paving shall begin along the centerline of the pavement on a crowned section or on the greatest contour elevation of a pavement with variable cross slope.*

306-5.5 HANDLING, MEASURING, AND BATCHING MATERIAL. *The batch plant site, layout, equipment, and provisions for transporting material shall assure a continuous supply of material to the work. Stockpiles shall be constructed in a manner that prevents segregation and intermixing of deleterious materials.*

Aggregates that have become segregated or mixed with earth or foreign material shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Rail shipments requiring more than 12 hours transit will be accepted as adequate binning only if the car bodies permit free drainage.

Batching plants shall be equipped to proportion aggregates and bulk cement, by weight, automatically using interlocked proportioning devised of an approved type. When bulk cement is used, the Contractor shall use a suitable method of handling the cement from weighing hopper to transporting container or into the batch itself for transportation to the mixer, such as a chute, boot or other device approved by the Engineer, to prevent loss of cement. The device shall be arranged to provide positive assurance that the required cement content is present in each batch.

306-5.6 MIXING. *All econocrete shall be mixed and delivered to the site in accordance with the requirements of ASTM C 94. The mixing time should be adequate to produce econocrete that is uniform in appearance, with all ingredients evenly distributed. Mixing time shall be measured from the time all materials are emptied into the drum (provided all the water is added before one-fourth the preset mixing time has elapsed) and continues until the time the discharge chute is opened to deliver the econocrete.*

If mixing in a plant, the mixing time shall not be less than 50 nor greater than 90 seconds. If mixing in a truck, the mixing time shall not be less than 70 nor more than 125 truck-drum revolutions at a mixing speed of not less than 6 nor more than 18 truck-drum revolutions per minute.

Retempering econocrete by adding water or by other means will not be permitted, except when econocrete is delivered in truck mixers. With truck mixers, additional water may be added to the batch materials and additional mixing



performed to allow proper placement of the material, provided (a) the addition of water is performed within 45 minutes after the initial mixing operations and (b) the water/cementitious ratio specified in the mix design is not exceeded.

306-5.7 HAULING. *The elapsed time from the addition of cementitious material to the mix until the econocrete is deposited in place at the work site shall not exceed 45 minutes when the concrete is hauled in nonagitator trucks, nor 90 minutes when it is hauled in truck mixers or truck agitators.*

306-5.8 PLACING, CONSOLIDATING, AND FINISHING. *Prior to placement of the econocrete layer, the prepared underlying course shall be well moistened with water, without saturating, in order to prevent rapid loss of moisture from the econocrete. In cold weather, the underlying course shall be protected so that it will be entirely free of frost when econocrete is placed.*

The Contractor has the option of side- (fixed-) form or slip-form paving. Under both techniques, the hauled econocrete material shall be discharged onto the prepared underlying course such that segregation of the mix is minimized and minimum handling of the mix is needed. Placement of the econocrete material shall be continuous between construction joints. Workers shall not be allowed to walk in the freshly mixed econocrete with boots or shoes coated with earth or debris.

Econocrete shall not be mixed, placed, or finished when the natural light is insufficient, unless an adequate artificial lighting system is provided.

306-5.8.1 Side-Form Construction. *For side-form placement, the Contractor shall verify the elevations of the fixed forms such that the thickness and finished grade of the econocrete layer will be in accordance with the requirements of the project plans and specifications. The econocrete shall be spread uniformly between the forms, immediately after it is placed using a spreading machine. Necessary hand spreading shall be done with shovels, not rakes.*

The spreading shall be followed immediately by thorough consolidation using vibrating screeds or spud vibrators. Vibrators may be external or internal type, depending on the thickness of the econocrete layer. The surface vibrators may be attached to the spreader or they may be mounted on a separate carriage. They shall not come in contact with the joint, subgrade, or side forms. When spud vibrators are used, the econocrete shall be thoroughly consolidated against and along the faces of all forms and previously placed econocrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. In no case shall the vibrator be operated longer than 20 seconds in any one location, nor shall the vibrators be used to move the econocrete.



Hand finishing will not be permitted except in areas where the mechanical finisher cannot operate.

306-5.8.2 Slip-Form Construction. *For slip-form construction, the Contractor shall verify the elevations of the guide wires controlling slip-form pavers such that the thickness and finished grade of the econocrete will be in accordance with the requirements of the project plans and specifications. The slip-form paver should spread, consolidate, and shape the freshly placed econocrete in one complete pass of the machine. The machine shall vibrate and finish the econocrete for the full width and depth of the layer.*

306-5.9 Final Finishing. *Final finishing shall be accomplished while the econocrete is still in the plastic state. Limited surface refinishing by hand is acceptable to meet the grade and surface tolerance established in paragraphs 306-6.2.3 and 306-6.2.4, after strike off and consolidation.*

If the overlying layer is to be PCC pavement, the surface of the econocrete shall not be textured. If the overlying layer is to be HMA pavement, and if the bond between the HMA layer and the econocrete is considered important for pavement performance, tining or scarifying the surface to provide a coarse texture may be permitted.

306-5.10 JOINTS. *Joints shall be constructed as shown on the plans.*

306-5.10.1 Construction Joints. *Locate all longitudinal and transverse construction joints as shown on the plans. If longitudinal joints are not shown, locate longitudinal joints within 6 in from planned joints in the PCC to be placed over the econocrete.*

306-5.10.2 Contraction Joints. *If required by paragraph 306-3.1.1 or if shown on the plans, transverse contraction joints shall be constructed by sawing the hardened econocrete to a depth of at least one-third the thickness of the econocrete base. These joints shall match within 3 in the planned joints of the overlying concrete surface.*

306-5.10.3 Concrete Saws. *When sawing of joints are specified, the Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions and at the required rate. The Contractor shall provide at least one standby saw in good working order. An ample supply of saw blades shall be maintained at the site of the work at all times during sawing operations. The Contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the job both before and at all times during econocrete placement.*



306-5.11 CURING. *Immediately after the finishing operations are complete and within 2 hours of placement of the econocrete, the entire surface and edges of the newly placed econocrete shall be sprayed uniformly with white pigmented, liquid membrane forming curing compound. The layer should be kept moist using a moisture-retaining cover or a light application of water until the curing material is applied. The curing compound shall not be applied during rainfall.*

The curing material shall be applied using mechanical sprayers under pressure at the rate of 1 gal to not more than 200 ft². The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound in the tank shall be in a thoroughly mixed condition with the pigment uniformly distributed throughout the vehicle. During application the compound shall be stirred continuously by mechanical means.

Hand spraying of odd widths or shapes and econocrete surfaces exposed by the removal of forms is permitted.

Should the film of curing material become damaged from any cause, including sawing operations, within the required 28-day curing period or until the overlying course is constructed, the damaged portions shall be repaired immediately with additional compound or other approved means as quickly as practical.

Edges of the econocrete layer shall be sprayed with curing compound immediately following placement with slip-form pavers or when side-forms are removed.

306-5.11.1 Curing in Cold Weather. *The econocrete shall be maintained at a temperature of at least 50°F (10°C) for a period of 72 hours after placing and at a temperature above freezing for the remainder of the curing time. The Contractor shall be responsible for the quality and strength of the econocrete placed during cold weather, and any econocrete injured by frost action shall be removed and replaced at the Contractor's expense.*

306-5.11.2 Curing in Hot Weather. *When econocrete is being placed and the air temperature may be expected to rise above 90°F (32°C) shortly after placement, the econocrete layer should be cured as quickly as possible to allow curing without the formation of excessive shrinkage cracks.*

306-5.12 PROTECTION. *The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the Contractor's employees and agents. The Engineer shall decide when the pavement shall be opened to traffic. Traffic shall not be allowed on the pavement until test specimens molded and cured in accordance with ASTM C 31 have attained a compressive strength of 350 psi when tested by ASTM C 39. The econocrete surface shall be protected from foot and vehicular traffic and other sources of*



abrasion until such a time. During this time, the econocrete layer shall be protected from injurious action by sun, rain, flowing water, frost, or mechanical injury. After this period, construction traffic to place the overlying layers may be allowed.

306-5.13 BOND-BREAKER. When the econocrete is to be placed directly beneath PCC pavement, a bond-breaker shall be used. The entire surface of the econocrete shall be coated with a de-bonding compound applied in a quality sufficient to prevent bonding of the PCC pavement to the econocrete. If an impervious membrane or asphalt emulsion is used as a curing material, additional applications of curing materials may be required. The Contractor shall be responsible for selecting the de-bonding compound and determining the necessary application rate. The de-bonding compound shall be approved by the Engineer prior to being incorporated into the work. This application shall be made at least 8 hours and not more than 24 hours prior to beginning the placement of the PCC pavement. The rate of application shall be the same as that specified for the curing application. After application of the bond-breaker coat, traffic will be limited to that required for the placement of the overlying pavement layer.

A ¼-inch thick layer of fine sand distributed evenly over the econocrete surface ahead of the PCC paver will be an acceptable bond-breaker.

MATERIAL ACCEPTANCE

306-6.1 ACCEPTANCE SAMPLING AND TESTING. All acceptance sampling and testing, with the exception of coring for thickness determination, necessary to determine conformance with the requirements specified in this section will be performed by the Engineer. The Contractor shall provide the required econocrete samples during construction for acceptance testing purposes. The samples shall be taken in the presence of the Engineer.

The econocrete layer shall be tested for air content, strength, thickness, grade, and surface tolerance. Sampling and testing for air shall be as specified in paragraph 306-6.1.1. Sampling and testing for strength, thickness, grade, and surface tolerance shall be on a lot basis, with a lot consisting of one of the following:

- One day's production not to exceed 2,000 yd².
- A half day's production, where a day's production is expected to consist of between 2,000 and 4,000 yd².

Each lot will be divided into four equal sublots. In the event that only three (3) sublots are produced, the three sublots shall constitute a complete lot. If, only one (1) or two (2) sublots are produced, they shall be incorporated into the next



lot, and the total number of sublots shall be used in the acceptance plan calculation.

End-of-production sublots (i.e., sublots associated with the final placement of econocrete for the project and are less than a complete lot) shall be handled as:

- Three (3) sublots shall constitute a lot.
- One (1) or (2) sublots shall be incorporated into the previous lot.

306-6.1.1 Air Content Testing. Air content tests shall be performed on the first three truckloads of econocrete produced at the start of operations each day and the first three truckloads produced after any scheduled or non-scheduled shutdown. Additional tests shall be performed each time a sample is taken for a strength test and when requested by the Engineer.

Air content tests shall be made in accordance with ASTM C 231. Air content test results shall be between 4 and 8 percent.

If the first test on a truckload of econocrete is not within the specification limits, a second test on the same truckload shall be made. If the second test is within the specification limits, the econocrete will be accepted with respect to entrained air content. If the second test is not within the specification limits, the truckload shall be rejected.

306-6.1.2 Compressive Strength Testing. One sample of freshly delivered econocrete shall be taken from each subplot for compressive strength testing. The econocrete shall be sampled in accordance with ASTM C 172. Sampling locations shall be determined in accordance with the random sampling procedures contained in ASTM D 3665.

At least two (2) test cylinders shall be made from each sample in accordance with ASTM C 31. The 7-day and 28-day compressive strength of each cylinder shall be determined in accordance with ASTM C 39.

Since the strength level of econocrete at an early age is considerably lower than PCC, special care is required in handling test specimens.

The Contractor shall provide adequate facilities for the initial curing of cylinders. During the 24 hours after molding, the temperature immediately adjacent to the specimens must be maintained in the range of 60 to 80°F (16 to 27°C), and loss of moisture from the specimens must be prevented. The specimens may be stored in tightly constructed wooden boxes, damp sand pits, temporary buildings at construction sites, under wet burlap in favorable weather or in heavyweight closed plastic bags, or use other suitable methods, provided the temperature and moisture loss requirements are met.



The compressive strength for each subplot shall be computed by averaging the 7-day and 28-day compressive strengths of the two test cylinders representing that subplot. The compressive strength of the lot shall be the average compressive strength of the individual sublots comprising the lot.

Specimens that are noticeably defective shall not be considered in the determination of the strength. If the test specimens fail to conform to the requirements for strength, the Engineer shall request changes in the econocrete mixture to increase the strength to meet the requirements.

If the maximum 7-day or 28-day compressive strength values exceed the maximum strength requirements when evaluated in accordance with paragraph 306-6-2.1, the Contractor shall propose a jointing plan for approval by the Engineer.

306-6.1.3 Thickness Testing. *After the econocrete base has cured for 3 days, one (1) 4-in diameter core per subplot shall be obtained from a random location, as identified using the procedures contained in ASTM D 3665. The thickness of each sampled core shall be determined using the caliper measurement procedures provided by ASTM C 174. The average thickness for the lot shall be determined using the individual subplot core thicknesses. Acceptance criteria for econocrete thickness are provided in paragraph 306-6.2.2.*

When such measurement is deficient more than 1/2 in and not more than 1 in from the plan thickness, two additional cores shall be taken at random and used in determining the average thickness for that lot. The thickness of the cores shall be determined by average caliper measurement of cores tested in accordance with ASTM C 174.

At all locations where cores have been drilled, the resulting holes shall be filled with econocrete or non-shrink grout material, as approved by the Engineer.

306-6.1.4 Grade Testing. *The elevations of the finished econocrete shall be surveyed on both sides of the econocrete lane, every 25 ft.*

306-6.1.5 Surface Tolerance Testing. *After the econocrete has hardened sufficiently, it shall be tested for surface tolerance with a 16-ft straightedge provided by the Contractor.*

306-6.2 ACCEPTANCE CRITERIA. *Acceptance of econocrete will be based on compressive strength, thickness, grade, and surface tolerance, as described in the paragraphs below.*



306-6.2.1 Compressive Strength Requirements. *The econocrete shall meet all of the following compressive strength requirements on a lot basis:*

- *The compressive strength of the lot, tested at 7 days, shall be greater than 500 psi. When a given lot of econocrete fails to meet the minimum compressive strength requirements, the entire lot shall be replaced at the Contractor's expense.*
- *Not more than 20 percent of the individual cylinders in a given lot, tested at 7 days, shall have a compressive strength greater than 750 psi, or greater than 1,000 psi at 28-days. When greater than 20 percent of the individual cylinders in a given lot have 7-day compressive strengths in excess of 750 psi, or have 28-day compressive strengths in excess of 1,000 psi, transverse joints shall be constructed.*
- *Econocrete that fails to meet the lower end compressive strength requirements will be removed and replaced at the Contractor's expense.*

306-6.2.2 Thickness Requirements. *The completed thickness shall be as shown on the plans. When the average lot thickness is not deficient by more than ½ in from the plan thickness, full payment shall be made. If the lot average thickness is deficient by more than 1 in, it shall be removed and replaced at the Contractor's expense. When such measurement is deficient more than ½ in and not more than 1 in from the plan thickness, one additional core shall be taken at random from each subplot within the lot. The thickness of these additional cores shall be determined as indicated in paragraph 304-6.1.2. A new lot average thickness shall be recomputed based on these additional cores and the original cores taken from each subplot. When the recomputed average lot thickness is not deficient by more than ½ in from the plan thickness, full payment shall be made. If the average lot thickness is deficient by more than ½ in from the plan thickness, the entire lot shall be removed and replaced at the Contractor's expense or shall be permitted to remain in place at an adjusted payment of 75 percent of the contract unit price.*

When the measured thickness is more than that indicated on the plans, it will be considered as conforming to the requirements, provided the surface of the completed econocrete layer is within the established grade and surface tolerance requirements.

306-6.2.3 Grade Requirements. *When the completed surface is more than ½ in above the grade shown in the plans, the surface shall be trimmed at the Contractor's expense using an approved grinding machine to an elevation that falls within a tolerance of ¼ in. The ground surface shall be sprayed with curing compound at double the rate specified prior to paving.*



306-6.2.4 Surface Tolerance Requirements. *Surface deviations shall not exceed $\frac{3}{8}$ in from a 16-ft straightedge laid in any location parallel with or at right angles to the longitudinal axis of the centerline (includes along all edges of the paving lane). Any high spots of more than $\frac{3}{8}$ inch in 16 ft shall be marked and immediately trimmed with an approved grinding machine. If the overlying layer is PCC pavement, the ground surface shall be sprayed with a double application of the curing compound at the specified rate prior to paving.*

METHOD OF MEASUREMENT

306-7.1 *See Section 33-2.*

BASIS OF PAYMENT

306-8.1 *See Section 33-3.*

TESTING REQUIREMENTS

<i>ASTM C 31</i>	<i>Making and Curing Concrete Test Specimens in the Field</i>
<i>ASTM C 39</i>	<i>Compressive Strength of Cylindrical Concrete Specimens</i>
<i>ASTM C 136</i>	<i>Sieve or Screen Analysis of Fine and Course Aggregates</i>
<i>ASTM C 172</i>	<i>Sampling Freshly Mixed Concrete</i>
<i>ASTM C 173</i>	<i>Air Content of Freshly Mixed Concrete by the Volumetric Method</i>
<i>ASTM C 174</i>	<i>Measuring Length of Drilled Concrete Cores</i>
<i>ASTM C 192</i>	<i>Making and Curing Concrete Test Specimens in the Laboratory</i>
<i>ASTM C 231</i>	<i>Air Content of Freshly Mixed Concrete by the Pressure Method</i>
<i>ASTM D 560</i>	<i>Standard Test Methods for Freezing and Thawing Compacted Soil-Cement Mixtures</i>
<i>ASTM D 3665</i>	<i>Random Sampling of Paving Materials</i>
<i>AASHTO T 26</i>	<i>Quality of Water to be Used in Concrete</i>

MATERIAL REQUIREMENTS



<i>ASTM C 33</i>	<i>Specification for Concrete Aggregates</i>
<i>ASTM C 94</i>	<i>Specification for Ready-Mixed Concrete</i>
<i>ASTM C 150</i>	<i>Specification for Portland Cement</i>
<i>ASTM C 260</i>	<i>Specification for Air-Entraining Admixtures for Concrete</i>
<i>ASTM C 309</i>	<i>Specification for Liquid Membrane-Forming Compounds for Curing Concrete</i>
<i>ASTM C 494</i>	<i>Specification for Chemical Admixtures for Concrete</i>
<i>ASTM C 595</i>	<i>Standard Specification for Blended Hydraulic Cements</i>
<i>ASTM C 618</i>	<i>Specification for Fly Ash and Raw and Calcined Natural Pozzolans for Use in Portland Cement Concrete</i>
<i>ASTM C 989</i>	<i>Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars</i>

END P-306

33-2 METHOD OF MEASUREMENT

The quantity of econocrete to be paid for will be determined by the number of square yards of econocrete actually constructed and accepted by the Engineer as complying with the plans and specifications.

Sawcutting for excessive strength econocrete will not be measured for payment but will be considered to be an incidental to the Contractor's price for remediation for providing excessive strength material.

Bond-breaker will not be measured for payment but will be considered to be an incidental to Econocrete Base Course.

33-3 BASIS OF PAYMENT

The accepted quantities of econocrete will be paid for at the contract unit price per square yard for econocrete base. The price and payment shall be full compensation for furnishing and



placing all materials, provided; however, for any pavement found deficient in thickness as specified in paragraph 306-6.2.2, the reduced unit price shall be paid.

No separate payment will be made for constructing the item under construction sequencing restrictions, including limited access or nighttime work areas.

Payment will be made under:

Item 33.1 Econocrete Base Courseper square yard

END OF SECTION 33



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