

AM-494.4

AC 150/5370-10

CHANGE 16

DATE 12/31/81

# ADVISORY CIRCULAR

CHANGE



DEPARTMENT OF TRANSPORTATION  
Federal Aviation Administration  
Washington, D.C.

**Subject:** Change 16 to STANDARDS FOR SPECIFYING CONSTRUCTION OF AIRPORTS--  
Issues a New Standard.

1. **PURPOSE.** This Change adds Item P-306, Econocrete Subbase Course, a new standard designed to utilize low cost, locally available aggregates and recycled materials that do not necessarily meet standards for normal concrete aggregates.

The Change number and date of the material is carried at the top of each page.

## PAGE CONTROL CHART

Remove Pages	Dated	Insert Pages	Dated
		260-1 thru 260-18	12/31/81

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LEONARD E. MUDD

Director, Office of Airport Standards

Suggest filing this transmittal at the back of the AC. It will provide a reference authority for changes, a method of determining that all Changes have been received, and a check for determining if the AC contains the proper pages.

Initiated by: AAS-200

ITEM P-306 ECONOCRETE SUBBASE COURSE 1.5  
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1. DESCRIPTION	3
1.1 This item shall consist of a subbase course composed of aggregate and cement uniformly blended together and mixed with water. The mixed material shall be spread, shaped, and compacted in accordance with these specifications and in conformity to the lines, grades, dimensions, and typical cross sections shown on the plans.	5 6 9 10 13 13
2. MATERIALS	15
2.1 AGGREGATE. The aggregate shall be stone or gravel, crushed or uncrushed. The fine aggregate shall be that naturally contained in the aggregate material or may be sand. The aggregate shall consist of hard, durable particles, free from excess flat, elongated, soft pieces, dirt, or other objectionable matter. The aggregate may also be a slag suitable for concrete.	19 20 21 23 27 28
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.	30 31 31
*****	35.1
1. The Engineer may specify crushed portland cement concrete pavement if the existing pavement or material on hand is to be recycled.	36 37 37
2. The Engineer may specify the limits for deleterious materials contained in ASTM C33.	39 40
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The aggregate shall conform to any one of the gradations shown in Table 1 when tested in accordance with ASTM C136.	46 47

## ITEM P-306 ECONOCRETE SUBBASE COURSE

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TABLE 1 AGGREGATE - ECONOCRETE BASE COURSE

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Sieve Size (Square Openings)	Percentage by Weight Passing Sieves		
	A	B	C
2 in. (50.8 mm)	100		
1-1/2 in. (38.1 mm)		100	
1 in. (25.4 mm)	55-85	70-95	100
3/4 in. (19.0 mm)	50-80	55-85	70-100
No. 4 (4.75 mm)	30-60	30-60	35-65
No. 40 (450 micro-m)	10-30	10-30	15-30
No. 200 (75 micro-m)	0-15	0-15	0-15

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 Where locally available aggregate cannot economically be  
 blended to meet the grading requirements, or if recycled  
 pavement is used, the gradations may be modified by the  
 design Engineer to fit the characteristics of the available  
 aggregates provided strength requirements are met.  
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2.2 CEMENT. Cement shall conform to the requirements of ASTM  
 C150, Type I.

2.3 WATER. Water used in mixing or curing shall be as clean and  
 free of oil, salt, acid, alkali, sugar, vegetable, or other  
 substances injurious to the finished product as possible. Water  
 will be tested in accordance with the requirements of AASHTO T26.  
 Water known to be of potable quality may be used without testing.

2.4 COVER MATERIAL FOR CURING. Curing materials shall conform  
 to one of the following specifications:

(a) Liquid membrane-forming compounds for curing econocrete  
 shall conform to the requirements of ASTM C309, Type 2, class A  
 or B.

(b) Asphalt emulsion for curing econocrete shall conform to  
 the requirements of ASTM D977, Type SS-1h.

2.5 ADMIXTURES. The use of any material added to the econocrete  
 mix shall be approved by the Engineer. The Contractor shall  
 submit certificates indicating that the material to be furnished  
 meets all the requirements listed below. In addition, the

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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:

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(a) Pozzolanic Admixtures. Pozzolanic admixtures shall be fly ash or raw or calcined natural pozzolans meeting the requirements of ASTM C618.

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(b) Air-Entraining Admixtures. Air-entraining admixtures shall meet the requirements of ASTM C260.

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(c) Water Reducing Admixtures. Water-reducing, set-controlling admixtures shall meet the requirements of ASTM C494, 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.

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Since the cement content is low in econocrete (which could cause poor workability for normal aggregates), the workability may be increased by extra fines in the aggregate; higher than normal amounts of entrained air; addition of pozzolanic admixtures or workability agents; or a combination of these.

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3. CONSTRUCTION METHODS

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3.1 PROPORTIONING. Prior to the start of paving operations and after approval of all material to be used, the Contractor shall submit test data showing the proportions of materials used and the actual compressive strength obtained from the econocrete. Compressive strength shall be not less than 500 psi at 7 days and 750 psi at 28 days using test specimens prepared in accordance with ASTM C192 and tested in accordance with ASTM C39. The minimum allowable cement content shall be 200 pounds per cubic yard.

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The Engineer may wish to specify an upper limit of 1200 psi since a compressive strength greater than 1200 psi may induce cracking in the overlying pavement.

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Air-entraining admixture shall be added in such a manner that will ensure uniform distribution of the agent throughout the batch. The air content of freshly mixed air-entrained econocrete shall be based upon trial mixes with the materials to be used in the work adjusted to produce a mixture of the required plasticity and workability. The percentage of air entrainment shall not be

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less than 4 percent or more than 9 percent. Air content shall be determined by testing in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag and other highly porous coarse aggregate. The mix shall have a slump of 1 to 3 inches (25 to 75 mm) at the time of placing the econocrete. Testing shall be in accordance with ASTM C143.

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1. In locations subject to considerable freeze-thaw cycles, the Engineer should specify that the freeze-thaw weight loss should not exceed 14 percent when tested in accordance with ASTM D560.

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2. The air content should be a minimum of 7 percent if the econocrete will be subject to freeze-thaw cycles.

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3.2 EQUIPMENT. Equipment and tools necessary for handling materials and performing all parts of the work shall be approved by the Engineer as to design, capacity, and mechanical condition. The equipment shall be at the job site before the start of construction operations for examination and approval.

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(a) Batching Plant and Equipment.

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(1) General. The batching plant shall include bins, weighing hoppers, and scales for the fine aggregate and coarse aggregate. If bulk cement is used, a bin, hopper, and separate scale for cement shall be included. The weighing hoppers shall be properly sealed and vented to preclude dusting during operation.

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(2) Bins and Hoppers. Bins with adequate separate compartments for fine aggregate and coarse aggregate shall be provided in the batching plant. Each compartment shall discharge efficiently and freely into the weighing hopper. Means of control shall be provided so that, as the quantity desired in the weighing hopper is approached, the material may be added slowly and shut off with precision. Weighing hoppers shall be constructed to eliminate accumulations of materials and to discharge fully.

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(3) Scales. The scales for weighing aggregates and cement shall be of either the beam or the springless dial type. They shall be accurate within 0.5 percent throughout their range of use. When beam-type scales are used, provisions such as "telltale" dial shall be made for indicating to the operator that the required load in the weighing hopper is being approached. A device on the weighing beams shall clearly indicate critical position. Poises shall be designed to be locked in any position and to prevent unauthorized change. The weight beam and "telltale" device shall be in full view of the operator while

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charging the hopper, and the operator shall have convenient access to all controls.

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Scales shall be inspected and sealed as often as the Engineer may deem necessary to assure their continued accuracy. The Contractor shall have on hand not less than ten 50-pound (25 kg) weights for testing all scales when directed by the Engineer.

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(b) Mixers.

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(1) General. Econocrete may be mixed at a central plant, or wholly or in part in truck mixers. 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.

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A device accurate within 3 percent and satisfactory to the Engineer shall be provided at the mixer for determining the amount of air-entraining agent or other admixture to be added to each batch requiring such admixtures.

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Mixers shall be examined daily for the accumulation of hard concrete or mortar and the wear of blades.

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(2) Central plant mixer. Mixing shall be in an approved mixer capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period, and of discharging the mixture without segregation. Central plant mixers shall be equipped with an acceptable timing device that will not permit the batch to be discharged until the specified mixing time has elapsed. The water system for a central mixer shall be either a calibrated measuring tank or a meter and shall not necessarily be an integral part of the mixer.

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The mixers shall be examined daily for changes in condition due to accumulation of hard concrete or mortar or wear of blades. The pickup and throwover blades shall be replaced when they have worn down 3/4 inch (19 mm) or more. The Contractor shall have a copy of the manufacturer's design on hand showing dimensions and arrangement of blades in reference to original height and depth.

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(3) Truck mixers and truck agitators. Truck mixers used for mixing and hauling econocrete and truck agitators used for hauling central-mixed econocrete shall conform to the requirements of ASTM C94.

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(4) Nonagitator trucks. Nonagitator hauling equipment shall conform to the requirements of ASTM C94.

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(c) Finishing Equipment.

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(1) Finishing machine. The finishing machine shall be equipped with one or more oscillating-type transverse screeds. 286  
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(2) Vibrators. For side-form construction, vibrators may be either the surface pan type for pavements less than 8 inches (20 cm) 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. The frequency of the surface vibrators shall not be less than 3,500 vibrations per minute, and the frequency of the internal type shall not be less than 7,000 vibrations per minute for spud vibrators. When spud-type internal vibrators are used adjacent to the side forms, they shall have a frequency of not less than 3,500 vibrations per minute. 290  
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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 with a frequency range variable between 7,000 and 12,000 vibrations per minute. The amplitude of vibration shall be between 0.025 (0.6 mm) and 0.06 (1.5 mm) inches. 303  
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The number, spacing, frequency, and eccentric weights shall be provided as necessary to achieve an acceptable density 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 frequency of surface vibrators shall not be less than 3,500 vibrations per minute. The Contractor shall furnish a tachometer or other suitable device for measuring the frequency of the vibrators. The vibrators and tamping elements shall be automatically controlled so that they shall be stopped as forward motion ceases. Any override switch shall be of the spring-loaded, momentary-contact type. 312  
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(d) Concrete Saw. When sawing of joints is 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. 327  
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(e) Forms. Straight side forms shall be made of steel having a thickness of not less than 7/32 inch (6 mm) and shall be 335  
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furnished in sections not less than 10 feet (3 m) in length. 336  
 Forms shall have a depth equal to the prescribed edge thickness 337  
 of the econocrete without horizontal joint and a base width equal 338  
 to the depth of the forms. Flexible or curved forms of proper 339  
 radius shall be used for curves of 100-feet (31 m) radius or 340  
 less. Flexible or curved forms shall be of a design acceptable 341  
 to the Engineer. Forms shall be provided with adequate devices 342  
 for secure settings so that when in place they will withstand, 343  
 without visible spring or settlement, the impact and vibration of 345  
 the consolidating and finishing equipment. Flange braces shall 346  
 extend outward on the base not less than two-thirds the height of 347  
 the form. Forms with battered top surfaces and bent, twisted, or 350  
 broken forms shall be removed from the work. Repaired forms 351  
 shall not be used, except as approved by the Engineer. The top 353  
 face of the form shall not vary from a true plane more than 1/8 353  
 inch (3 mm) in 10 feet (3 m), and the upstanding leg shall not 354  
 vary more than 1/4 inch (6 mm). The forms shall contain 355  
 provisions for locking the ends of abutting sections together 355  
 tightly for secure setting. 356

(f) Slip-form Pavers. The paver shall be fully energized, 359  
 self-propelled, and designed for the specific purpose of placing, 361  
 consolidating, and finishing the econocrete pavement, true to 364  
 grade, tolerances, and cross section. It shall be of sufficient 367  
 weight and power to construct the maximum specified paving lane 367  
 width as shown in the plans, at adequate forward speed, without 370  
 transverse, longitudinal, or vertical instability or without 372  
 displacement. The paver shall be equipped with electronic or 373  
 hydraulic horizontal and vertical control devices. 373

3.3 FORM SETTING. Forms shall be set sufficiently in advance of 376  
 the econocrete placement to ensure continuous paving operation. 376  
 After the forms have been set to correct grade, the grade shall 378  
 be thoroughly tamped, either mechanically or by hand, at both the 380  
 inside and outside edges of the base of the forms. Forms shall 381  
 be staked into place with not less than 3 pins for each 10-foot 381  
 (3 m) section. A pin shall be placed at each side of every 383  
 joint. 383

Form sections shall be tightly locked and shall be free from play 385  
 or movement in any direction. The forms shall not deviate from 386  
 true line by more than 1/4 inch (6 mm) at any joint. Forms shall 387  
 be so set that they will withstand, without visible spring or 388  
 settlement, the impact and vibration of the consolidating and 389  
 finishing equipment. Forms shall be cleaned and oiled prior to 390  
 the placing of econocrete. 390

The alignment and grade elevations of the forms shall be checked 392  
 and corrections made by the Contractor immediately before placing 393  
 the econocrete. When any form has been disturbed or any grade 394  
 has become unstable, the form shall be reset and rechecked. 395



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3.4 CONDITIONING OF UNDERLYING COURSE, SLIP-FORM CONSTRUCTION.

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The compacted subgrade on which the pavement will be placed shall be widened approximately 3 feet (1 m) to extend beyond the paving machine track to support the paver without any noticeable displacement. After the subgrade has been placed and compacted to the required density, the areas which will support the paving machine and the area to be paved shall be trimmed to the proper elevation and profile by means of a properly designed machine. The grade of the subgrade on which the econocrete pavement is to be placed shall be controlled automatically by steel guide wires erected and maintained by the Contractor. If the density of the subgrade is disturbed by the trimming operations, it shall be corrected by additional compaction before the econocrete is placed. The grading operations should be delayed as long as possible and immediately precede paving insofar as practicable, particularly if the subgrade is subjected to haul traffic. If traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately before the placement of econocrete. The prepared grade shall be well moistened with water, without saturating, immediately ahead of econocrete placement 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.

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3.5 CONDITIONING OF UNDERLYING COURSE, SIDE-FORM CONSTRUCTION.

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The prepared grade shall be well moistened with water, without saturating, immediately ahead of econocrete placement to prevent rapid loss of moisture from the econocrete. Ruts or depressions in the subgrade caused by hauling or usage of other equipment shall be filled as they develop with suitable material and thoroughly compacted by rolling. A multiple-pin templet weighing not less than 1,000 pounds (450 kg) per 20 feet (6 m) or other approved templet shall be provided and operated on the forms immediately in advance of the placing of the econocrete. The templet shall be propelled only by hand and not attached to a tractor or other power unit. Templates shall be adjustable so that they may be set and maintained at the correct contour of the underlying course. The adjustment and operation of the templet shall be such as will provide an accurate retest of the grade before placing the econocrete thereon. All excess material shall be removed. Low areas may be filled and compacted to a condition similar to that of the surrounding grade, or filled with econocrete integral with the pavement. In cold weather, the underlying course shall be protected so that it will be entirely free from frost when the econocrete is placed. The use of chemicals to eliminate frost in the underlying material will not be permitted. The template shall be maintained in accurate adjustment, at all times by the Contractor, and should be checked daily. The work described under the foregoing paragraphs does not constitute a regular subgrading operation, but rather a final accurate check of the underlying course.

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3.6 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 built up in layers of not more than 3 feet (1 m) in thickness. Each layer shall be completely in place before beginning the next layer and shall not be allowed to "cone" down over the next lower layer. Aggregates from different sources and of different grading shall not be stockpiled together. Improperly placed stockpiles will not be accepted by the Engineer.

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Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner to secure the specified grading of the material. 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 will be accepted as adequate binning only if the car bodies permit free drainage. The fine aggregate and coarse aggregate shall be separately weighed into hoppers in the respective amounts set by the Engineer in the job mix except where a unit aggregate such as crusher run or pit run are used, in which case a single stockpile will be satisfactory. Cement shall be measured by weight. Separate scales and hopper, with a device to positively indicate the complete discharge of the batch of cement into the batch box or container, shall be used for weighing the cement.

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When required by the contract or when permitted, batching plants shall be equipped to proportion aggregates and bulk cement, by weight, automatically using interlocked proportioning devices of an approved type. 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 approved device, to prevent loss of cement. The device shall be arranged to provide positive assurance of the actual presence in each batch of the entire cement content specified.

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When cement is placed in contact with the aggregates, batches may be rejected unless mixed within 1 1/2 hours of such contact. Batching shall be conducted so that the results in the weights of each material required will be within a tolerance of 1 percent for cement and 2 percent for aggregates.

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Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within plus or minus 1 percent of required amounts. Unless the water is to be weighed, the water-measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled.

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Methods and equipment for adding air-entraining agent or other admixtures to the batch, when required, shall be approved by the Engineer. All admixtures shall be measured into the mixer with an accuracy of plus or minus 3 percent. 499  
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3.7 MIXING ECONOCRETE. The econocrete may be mixed at the work site, in a central mix plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials, except water, are emptied into the drum. Ready-mixed econocrete shall be mixed and delivered in accordance with the requirements of ASTM C94, except that the minimum required revolutions of the mixing speed for transit mixed econocrete may be reduced to not less than that recommended by the mixer manufacturer. The number of revolutions recommended by the mixer manufacturer shall be indicated on the manufacturer's serial plate attached to the mixer. The Contractor shall furnish test data acceptable to the Engineer verifying that the make and model of the mixer will produce uniform econocrete conforming to the provisions of ASTM C94 at the reduced number of revolutions shown on the serial plate. 505  
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When mixed at the work site or in a central mix plant, the mixing time shall not be less than 50 seconds nor more than 90 seconds. Mixing time ends when the discharge chute opens. Transfer time in multiple drum mixers is included in mixing time. The contents of an individual mixer drum shall be removed before a succeeding batch is emptied therein. 521  
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The mixer shall be operated at the drum speed as shown on the manufacturer's nameplate on the approved mixer. Any econocrete mixed less than the specified time shall be discarded at the Contractor's expense. The volume of econocrete mixed per batch shall not exceed the mixer's nominal capacity in cubic feet (cubic meters), as shown on the manufacturer's standard rating plate on the mixer. An overload up to 10 percent above the mixer's nominal capacity may be permitted provided test data for segregation and uniform consistency are satisfactory, and provided no spillage of econocrete takes place. The batch shall be charged into the drum so that a portion of the mixing water shall enter in advance of the cement and aggregates. The flow of water shall be uniform, and all water shall be in the drum by the end of the first 15 seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the free flow of materials into the drum. 527  
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Mixed econocrete from the central mixing plant shall be transported in truck mixers, truck agitators, or nonagitating trucks. The time elapsing from the time water is added to the mix until the econocrete is deposited in place at the work site shall not exceed 45 minutes when the econocrete is hauled in nonagitating trucks nor 90 minutes when the econocrete is hauled 543  
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in truck mixers or truck agitators. Retempering econocrete by adding water or by other means will not be permitted, except when econocrete is delivered in transit mixers. With transit mixers, additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements, if permitted by the Engineer. All these operations must be performed within 45 minutes after the initial mixing operations, and the water-cement ratio must not be exceeded. Admixtures for increasing the workability or for accelerating the set will be permitted only when approved by the Engineer. At the option of the Contractor or when specified by the Engineer, a water-reducing admixture may be used.

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3.8 LIMITATIONS OF MIXING. No econocrete shall be mixed, placed, or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

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Unless authorized in writing by the Engineer, mixing and econocreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40 degrees F (4 degrees C) and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35 degrees F (2 degrees C).

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When econocreting is authorized during cold weather, 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. Unless otherwise authorized, the temperature of the mixed econocrete shall not be less than 50 degrees F (10 degrees C) at the time of placement in the forms.

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If the air temperature is 35 degrees F (2 degrees C) or less at the time of placing econocrete, the Engineer may require the water and/or the aggregates to be heated to not less than 70 degrees F (21 degrees C) nor more than 150 degrees F (66 degrees C). Econocrete shall not be placed on frozen subgrade nor shall frozen aggregates be used in the econocrete.

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During the periods of warm weather when the maximum daily air temperature exceeds 85 degrees F (30 degrees C), the following precautions should be taken. The forms and/or the underlying material shall be sprinkled with water immediately before placing the econocrete. The econocrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the econocrete when placed exceed 100 degrees F (38 degrees 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.

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3.9 PLACING ECONOCRETE.

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(a) Side-Form Method. For the side-form method, the econocrete shall be deposited on the moistened grade to require as little rehandling as possible. Truck mixers, truck agitators, or nonagitating hauling equipment equipped with means for discharge of econocrete without segregation of the materials, shall unload the econocrete on the grade to prevent segregation of the materials. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels--not rakes. Workers shall not be allowed to walk in the freshly mixed econocrete with boots or shoes coated with earth or foreign substances.

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(b) Slip-Form Method. For the slip-form method, the econocrete shall be placed with an approved crawler-mounted, slip-form paver designed to spread, consolidate, and shape the freshly placed econocrete in one complete pass of the machine so that a minimum of hand finishing will be necessary to provide a pavement in conformance with requirements of the plans and specifications. Side forms and finishing screeds shall be adjustable to the extent required to produce the specified pavement edge and surface tolerance. The side forms shall be of dimensions, shape, and strength to support the econocrete laterally for a sufficient length of time so that no appreciable edge slumping will occur. Final finishing shall be accomplished while the econocrete is still in the plastic state.

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3.10 FIELD TEST SPECIMENS. Econocrete samples shall be furnished by the Contractor and shall be taken in the field to determine the consistency, air content, and strength of the econocrete. The samples shall be taken in the presence of the Engineer, at locations determined by the Engineer. Econocrete cylinders shall be made each day that the econocrete is placed. Each group of cylinders shall be molded from the same batch of econocrete and shall consist of a sufficient number of specimens to provide two compressive strength tests at each test age. One group of specimens will be made during the first half of each shift, and the other will be made during the last portion of the shift. The specimens shall be made in accordance with ASTM C31. However, at the start of paving operations and when the aggregate source, aggregate characteristics, or mix design is changed, additional groups of test cylinders may be required until the Engineer is satisfied that the econocrete mixture being used complies with the strength requirements of these specifications. Test ages will be 7 days and 28 days.

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ITEM P-306 ECONOCRETE SUBBASE COURSE

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At least one set of cylinders should be made for each 500  
cubic yards (380 cubic meters) or fraction thereof of  
econocrete placed.  
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Since the strength level of econocrete at an early age is  
considerably lower than pavement concrete, special care is  
required in handling test specimens. Cylinders should be field  
cured 48 hours prior to moving.

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The compressive strength of the econocrete shall meet the  
following requirements: (1) the average of any 4 consecutive  
strength tests, tested at the end of 28 days, shall have an  
average compressive strength equal to or greater than the  
specified compressive strength; (2) not more than 20 percent of  
the cylinders tested at the end of 28 days shall have a  
compressive strength less than the specified strength. Specimens  
which are obviously defective shall not be considered in the  
determination of the strength. When it appears that the test  
specimens will fail to conform to the requirements for strength,  
the Engineer shall have the right to order changes in the  
econocrete sufficient to increase the strength to meet these  
requirements. When a satisfactory relationship between 7-day and  
28-day strengths has been established and approved, the 7-day  
test results may be used as an indication of the 28-day  
strengths. However, the 7-day test results will not replace the  
results of the 28-day tests if the 28-day results fall below the  
requirements. Econocrete not meeting these requirements shall be  
replaced at the Contractor's expense.

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3.11 JOINTS. Transverse joints shall be constructed every 50  
feet (15 m). Joints shall be [sawed in the hardened econocrete]  
[formed in the plastic mixture] to depth of at least one-sixth  
the thickness of the econocrete base. All joints in the  
econocrete base shall be offset at least 6 inches (150 mm) from  
joints in the surface course.

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Joints are not considered necessary in econocrete subbases  
because of the normally lower strengths and moduli of  
elasticity of these subbases relative to these parameters in  
the overlying portland cement concrete pavement. When a  
relatively high strength econocrete subbase is placed  
(compressive strength greater than 1200 psi), joints should  
be constructed, unless a good bond breaker, such as a wax-  
based curing compound, is used between the econocrete and  
the overlying pavement.

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## ITEM P-306 ECONOCRETE SUBBASE COURSE

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Paragraph 3.11 should be deleted if the Engineer determines joints are not necessary.

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## 3.12 FINAL STRIKE-OFF, CONSOLIDATION, AND FINISHING.

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(a) Sequence. The sequence of operations shall be strike-off, consolidation, and finishing.

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(b) Strike-off, Consolidation, and Finishing. The econocrete shall be placed with a slip-form paver capable of striking-off, consolidating, and finishing in one pass of the equipment. Form-paving methods may be used at the Contractor's option.

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(c) Final Finishing. Hand finishing will not be permitted except in areas where the mechanical finisher cannot operate. The surface of the pavement shall not be textured.

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(d) Surface Testing and Corrections. After the econocrete base has been struck off and consolidated and while the econocrete is still plastic, it shall be tested for trueness with a 16-foot (4.8 m) straightedge. The surface shall show no variations of more than 3/8 inch (9 mm) from a 16-foot (4.8 m) straightedge laid in any location parallel with or at right angles to the longitudinal axis of the centerline. Any surplus material shall be removed and the surface refinished by hand. Any depressions shall be immediately filled with freshly mixed econocrete, struck off, consolidated, and refinished.

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3.13 CURING. Immediately after the finishing operations have been complete and marring of the econocrete will not occur, the entire surface of the newly placed econocrete shall be cured in accordance with one of the methods below. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of econocreting operations. The econocrete shall not be left exposed for more than 1/2 hour during the curing period. The following are alternate approved methods for curing econocrete pavements.

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(a) Impervious Membrane Method. The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the econocrete has taken place. The curing compound shall not be applied during rainfall. Curing compound shall be applied by mechanical sprayers under pressure at the rate of 1 gallon (4 liters) to not more than 200 square feet (18 square meters). The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of

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use, the compound shall be in a thoroughly mixed condition with pigment uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by effective mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed, but approved means shall be used to ensure proper curing for 72 hours. The curing compound shall be of such character that the film will harden within 30 minutes after application. Should the film become damaged from any cause within the required curing period, the damaged portions shall be repaired immediately with additional compound. Upon removal of side forms, the sides of the exposed slabs shall be protected immediately to provide a curing treatment equal to that provided for the surface.

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(b) Asphalt Emulsion. The entire surface of the pavement shall be uniformly sprayed with asphalt emulsion before the set of the econocrete has taken place. The asphalt emulsion shall be applied by distributing equipment at the rate of approximately 0.2 gallons (0.95 liter) per square yard (square meter). Should the film become damaged from any cause within the required curing period, the damaged portions shall be repaired immediately with additional asphalt emulsion.

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(c) Curing in Cold Weather. When the average daily temperature is below 40 degrees F (4 degrees C), curing shall consist of covering the newly laid pavement with not less than 12 inches (30 cm) of loose, dry hay or straw, or equivalent protective curing authorized by the Engineer, which shall be retained in place for 10 days. The hay or straw shall be secured to avoid being blown away.

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When econocrete is being placed and the air temperature may be expected to drop below 35 degrees F (2 degrees C), a sufficient supply of straw, hay, grass, or other suitable blanketing material such as burlap or polyethylene shall be provided along the work. Any time the temperature may be expected to reach the freezing point during the day or night, the material so provided shall be spread over the pavement to a sufficient depth to prevent freezing of the econocrete.

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The period of time such protection shall be maintained shall not be less than 10 days. 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.

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## ITEM P-306 ECONOCRETE SUBBASE COURSE

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3.14 PROTECTION OF ECONOCRETE. The Contractor shall protect the pavement against traffic caused by the Contractor's employees and agents. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, or crossovers, etc. The plans or special provisions will indicate the location and type of device or facility required to protect the work and provide adequately for traffic. Any damage to the subbase course occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor's expense. In order that the econocrete be properly protected against the effects of rain before the econocrete is sufficiently hardened, the Contractor will be required to have available at all times materials for the protection of the edges and surfaces of the unhardened econocrete. Such protective materials shall consist of rolled polyethylene sheeting at least 4 mils (0.1 mm) thick of sufficient length and width to cover the plastic econocrete slab and any edges. The sheeting may be mounted on either the paver or a separate movable bridge from which it can be unrolled without dragging over the plastic econocrete surface. When rain appears imminent, all paving operations shall stop and all available personnel shall begin covering the surface of the unhardened econocrete with the protective covering.

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Traffic shall not be permitted on the econocrete until a minimum compressive strength of 500 psi has been developed as determined from test specimens.

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3.15 TOLERANCE IN THICKNESS. Econocrete will be accepted for thickness on a lot basis. A lot will consist of [\*\* ] square yards (square meters). One core shall be taken at random by the Engineer in each lot. When the measurement of the core from a lot is not deficient more than 0.5 inch (12 mm) from the plan thickness, full payment will be made. When such measurement is deficient more than 0.5 inch (12 mm) and not more than 1 inch (25 mm) 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 C174. When the average measurement of the 3 cores is not deficient more than 0.5 inch (12 mm) from the plan thickness, full payment will be made. If the average measurement of the three cores is deficient more than 0.5 inch (12 mm) from the plan thickness, the entire lot shall be removed and replaced at the Contractor's expense or be permitted to remain in place at an adjusted payment of 75 percent of the contract unit price.

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When the average thickness is deficient by more than 1 inch (25 mm), the entire lot shall be replaced.

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## ITEM P-306 ECONOCRETE SUBBASE COURSE

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*****	864.1
The Engineer shall specify the lot size. The lot should	866
contain approximately 4000 square yards (3 350 square	866
meters) but not exceed a day's pour.	866
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#### 4. METHOD OF MEASUREMENT 872

4.1 The quantity to be paid for will be the number of square	874
yards (square meters) of econocrete completed and accepted as	875
measured complete in place, less deductions as required in	876
Paragraph 3.15 for deficient thickness.	876

#### 5. BASIS OF PAYMENT 878

5.1 The accepted quantities of econocrete will be paid for at	880
the contract unit price for square yard (square meter). The	882
price and payment shall be full compensation for furnishing and	882
placing all materials, provided, however, that for any pavement	885
found deficient in thickness as specified in Paragraph 3.15 the	886
reduced unit price shall be paid.	886

Payment will be made under: 888

Item P-306.1	Econocrete Base Course - per square yard (per	891
	square meter)	891

#### 6. TESTING REQUIREMENTS 893

ASTM C31	Making and Curing Concrete Test Specimens in the Field	896
		896
ASTM C39	Compressive Strength of Cylindrical Concrete Specimens	899
		899
ASTM C136	Sieve or Screen Analysis of Fine and Course Aggregates	902
		902
ASTM C143	Slump of Portland Cement Concrete	905
ASTM C173	Air Content of Freshly Mixed Concrete by the Volumetric Method	908
		908
ASTM C174	Measuring Length of Drilled Concrete Cores	911
ASTM C192	Making and Curing Concrete Test Specimens in the Laboratory	914
		914

## ITEM P-306 ECONOCRETE SUBBASE COURSE

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<u>ASTM C231</u>	<u>A</u> ir Content of Freshly Mixed Concrete by the Pressure Method	917 917
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<u>AASHTO T26</u>	<u>Q</u> uality of Water to be Used in Concrete	920
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7. <u>M</u> ATERIAL REQUIREMENTS		922
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<u>ASTM C33</u>	<u>S</u> pecification for Concrete Aggregates	925
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<u>ASTM C94</u>	<u>S</u> pecification for Ready-Mixed Concrete	928
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<u>ASTM C150</u>	<u>S</u> pecification for Portland Cement	931
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<u>ASTM C260</u>	<u>S</u> pecification for Air-Entraining Admixtures for Concrete	934 934
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<u>ASTM C309</u>	<u>S</u> pecification for Liquid Membrane-Forming Compounds for Curing Concrete	937 937
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<u>ASTM C494</u>	<u>S</u> pecification for Chemical Admixtures for Concrete	940 940
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<u>ASTM C618</u>	<u>S</u> pecification for Fly Ash and Raw and Calcined Natural Pozzolans for Use in Portland Cement Concrete	943 943 943
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<u>ASTM C977</u>	<u>S</u> pecification for Emulsified Asphalt	946
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+ + END OF Item P-306 + +		947.3
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