

May 18, 1967

MEMORANDUM

B. 2. 2

TO: W. B. Drake
Assistant State Highway Engineer

FROM: Jas. H. Havens
Director of Research

SUBJECT: Unit Weights of Paving Materials,
for Estimating Quantities

Pursuant to our assignment, continuation issuing from the meeting of March 29, 1967, with Messers Brunnhoeffler, Mathis, et al, the Research Division staff performed specific-gravity tests on an ensemble of gravel samples furnished by Mr. Mays and made further evaluations of those and other data available -- that is, for the purpose of deriving the best or most judicious unit weights -- with a minimum of areal and mineralogical differentiation. Because of previously-recognized variances in pavement densities, we elected to proceed on a theoretical basis. On the basis of assumed volume constants, it was possible to calculate theoretical unit weights. The real (measured) values of O. D., bulk, specific gravity and absorption were used in calculating the theoretical, unit weights for the respective aggregates.

Note: As a matter of possible interest concerning calculations of this type, two nomographs were prepared: one permits the interpolation of average, combined, specific gravity for a four-aggregate blend; the other permits interpolation of unit weights of bituminous mixtures when certain factors are known or assumed. Copies are appended.

As pointed out on previous occasions, the apparent specific gravity is highly indicative of the mineralogical composition of the aggregate; limestone (calcite) cannot exceed 2.72; quartz sand cannot exceed 2.64. Higher gravities indicate the presence of heavier minerals, such as dolomite and iron-bearing materials. Cherts, flints, granite, and other familiar siliceous aggregates are not likely to contain significant quantities of material having gravities greater than 2.64. Consequently, the principal differentiation, mineralogically, is: 1) high-lime aggregate, 2) dolomitic aggregate, 3) siliceous aggregate, and 4) blends or

combinations thereof. Whereas dolomitic rocks and gravels are potentially heavier than high-lime limestones, the dolomitic rocks tend to be more porous than limestones; and dolomitic gravels tend to be more porous than dolomitic ledge-rock -- the gravels are presumed to have been subjected to severe leaching environments -- and because of porosity, differences in bulk gravity (O.D.) may not be very significant. Of course, from the standpoint of unit weights, as considered here, the controlling gravity is the O. D. bulk; however, the more porous aggregates demand more asphalt in paving mixtures; and the higher asphalt content adds somewhat to the unit weight of mixture. Summarily, the constituent-mineral gravities provided a basis for classification and areal differentiation -- that is, grouping and averaging O.D. bulk gravity and absorption data.

By judicious grouping (delineated on the geological map appended hereto), the Upper Ohio Valley was considered to be a siliceous area; dolomitic gravels and sands occurred conformably in the Middle Ohio Valley; gravels from the Western Ohio Valley are predominately siliceous and conform with those from the Upper Ohio Valley; gravels from the Mississippi (Columbus, Hickman, etc.) area are also siliceous and in this respect are not differentiated from those from the Upper Ohio. Sands from the Lower Ohio area are distinctively cherty and low in gravity; but the Upper Ohio and Mississippi sands are the quite similar. Although these groupings were made for averaging test data, computed unit weights differentiated only the dolomitic (calcareous) glacial gravels from other Ohio Valley and Mississippi River sources (difference of 1% or more). A tabulation of gravel specific gravities is attached hereto (Note: Standard Slag's Haverhill source is listed unconformably with the Scioto River sources which should have been grouped with the Middle Ohio Area.)

Quarried limestones were also divided into two groups, i. e., high-lime and dolomitic. Unit weights failed to differentiate between them -- that is, to the extent of 1% or more.

Note: A difference of 1% or more was chosen as a level of significance.

The prominent dolomitic limestones in Kentucky are: 1) the Laurel Dolomite which is accessible in the vicinities of Louisville and Bardstown, 2) the Lilley Dolomite (Louisville Limestone), and 3) the Oregon (below the Tyrone Limestone).

A summary tabulation shows the reduced data; a following table presents recommended unit weights for bituminous mixtures and also includes a

May 18, 1967

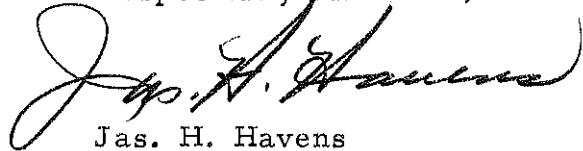
recommended value for dense-graded limestone bases (determined from the average of in-place data tabulated and appended hereto).

Note: Slag was not evaluated at this time; however, some data for in-place densities of slag, dense-graded base are tabulated with the limestone.

Other information appended consists of in-place densities of various, current, bituminous concrete, paving projects. Of special interest are recent core data from a controlled-rolling project constructed at Olive Hill in 1960; the original density data were furnished with my memorandum of February 14, 1967.

Finally, I have attached a copy of the current list (Road Drafting Office, 2-24-66) of counties showing alternative types of aggregates (for which bids are invited). This list may apply, without change, but in conjunction with our differentiation of the dolomitic gravel of the Middle Ohio Valley.

Respectfully submitted,



Jas. H. Havens

Director Division of Research

JHH:em

Attachments

cc: A. O. Neiser

J. T. Anderson

H. G. Mays

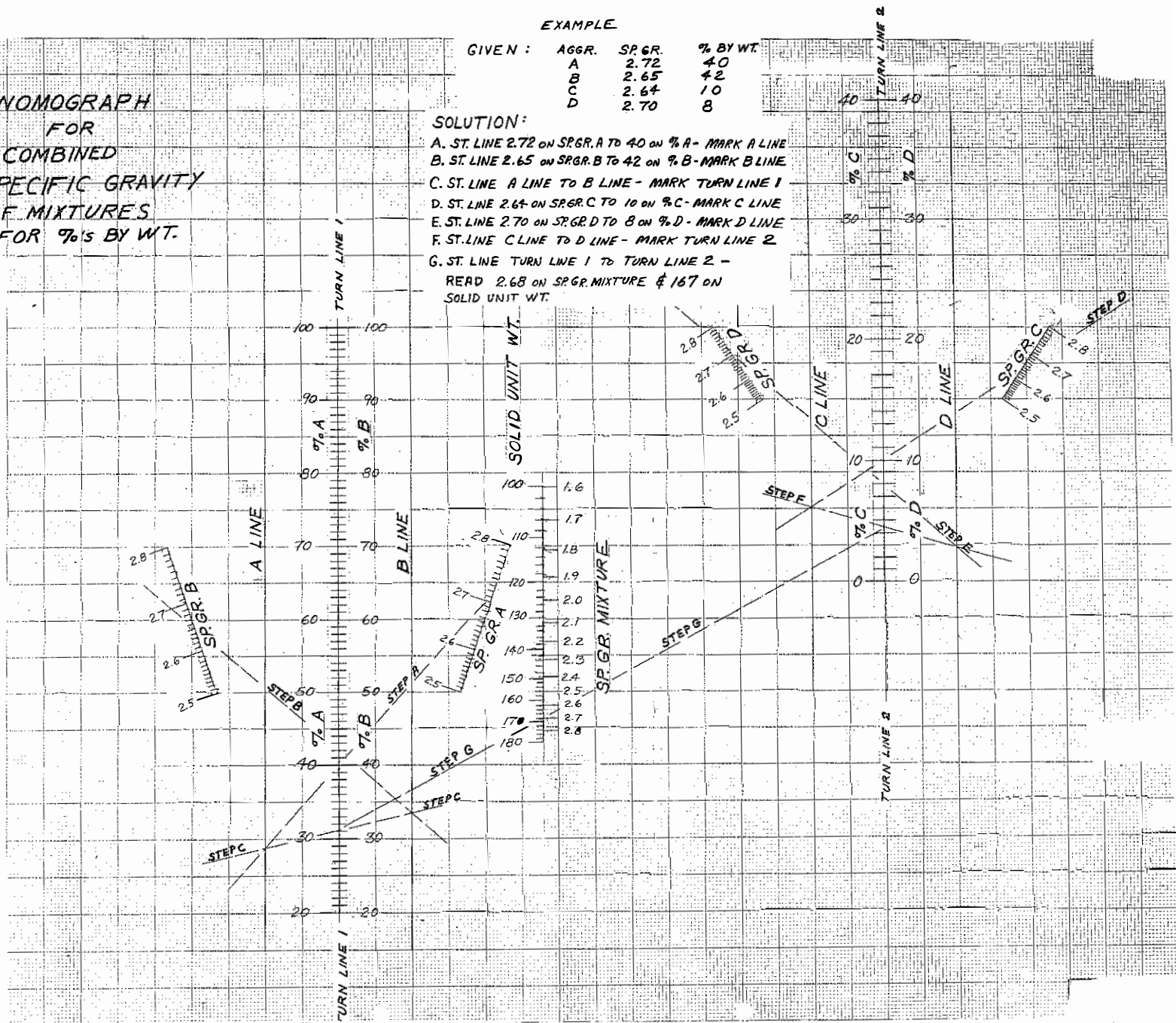
**NOMOGRAPH
FOR
COMBINED
SPECIFIC GRAVITY
OF MIXTURES
FOR %'s BY WT.**

EXAMPLE

| GIVEN : | AGGR. | SP.GR. | % BY WT. |
|---------|-------|--------|----------|
| | A | 2.72 | 40 |
| | B | 2.65 | 42 |
| | C | 2.64 | 10 |
| | D | 2.70 | 8 |

SOLUTION:

- ST. LINE 2.72 ON SP.GR. A TO 40 ON % A - MARK A LINE
- ST. LINE 2.65 ON SP.GR. B TO 42 ON % B - MARK B LINE
- ST. LINE A LINE TO B LINE - MARK TURN LINE 1
- ST. LINE 2.64 ON SP.GR. C TO 10 ON % C - MARK C LINE
- ST. LINE 2.70 ON SP.GR. D TO 8 ON % D - MARK D LINE
- ST. LINE C LINE TO D LINE - MARK TURN LINE 2
- ST. LINE TURN LINE 1 TO TURN LINE 2 -
READ 2.68 ON SP.GR. MIXTURE & 167 ON
SOLID UNIT WT.



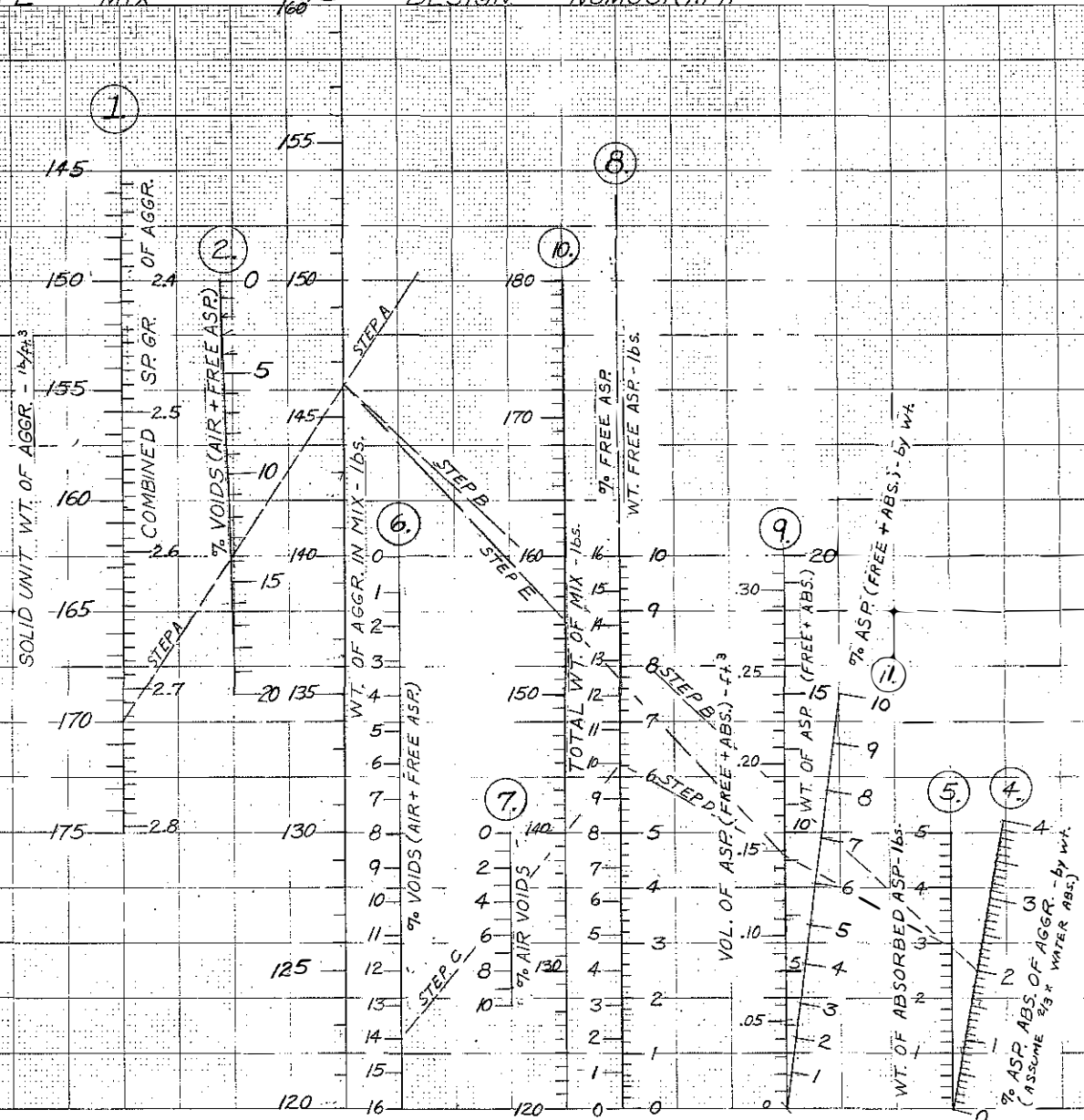
800

BITUMINOUS CONCRETE MIX DESIGN NOMOGRAPH

3.

EXAMPLE
 GIVEN: (1) COMB. SP. GR. AGGR. = 2.724
 UNIT WT. (solid) = 170 lb./ft.³
 (2) % ASP. ABS. OF AGGR. = 2
 (3) % VOIDS (AIR + FREE ASP.) = 14
 (4) % AIR VOIDS = 4

SOLUTION: (by steps)
 A. ST. LINE 170 ON (1) TO 14 ON (2) - READ 146.2 ON (3)
 B. ST. LINE 146.2 ON (3) TO 2 ON (4) - READ 2.92 ON (5)
 C. ST. LINE 14 ON (6) TO 4 ON (7) - READ 10% ON (8)
 OR 6.24 lbs. ON (8)
 D. ST. LINE 2.92 ON (5) TO 6.24 ON (9) - READ 9.16 ON (9)
 E. ST. LINE 9.16 ON (9) TO 146.2 ON (3) - READ
 155.4 ON (10) AND 5.9 ON (11)



606

Mississippi Valley Lower Ohio Valley Western Ohio Valley Middle Ohio Valley Upper Ohio Valley Scioto River

UNIVERSITY OF KENTUCKY
 KENTUCKY GEOLOGICAL SURVEY
 LEXINGTON, KY.
 Arthur C. McFarlan, Director
 Daniel J. Jones, State Geologist
 SERIES IX, 1954
 IN COOPERATION WITH
 AGRICULTURAL AND INDUSTRIAL DEVELOPMENT BOARD OF KENTUCKY
 FRANKFORT, KY.
GEOLOGIC MAP OF KENTUCKY

LEGEND

| | |
|----------------------------|---|
| RECENT | [Symbol] |
| TERTIARY | [Symbol] |
| CRETACEOUS | [Symbol] |
| PENNSYLVANIAN | [Symbol] |
| MISSISSIPPIAN | [Symbol] |
| MISSISSIPPIAN AND DEVONIAN | [Symbol] |
| DEVONIAN | [Symbol] |
| SILURIAN | [Symbol] |
| OROVICIAN | [Symbol] |
| FAULT | [Symbol] |
| | [Symbol] Chester and Meramec |
| | [Symbol] Chert |
| | [Symbol] Indiferentiation (Pine Stria area) |
| | [Symbol] Cincinnati |
| | [Symbol] Chert Blotches |

Adapted with minor revisions from geologic maps of Kentucky dated 1927 and 1929 by W. R. Julian
 SCALE 1:100,000

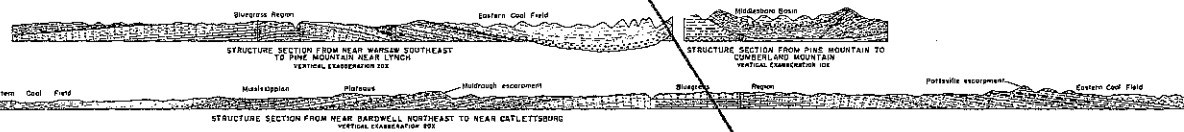
Cherty, Siliceous Gravels and Sands

Dolomitic Gravels and Sands

Siliceous Gravels and Sands

Chert Zone

Siliceous Gravel and Sands



Dolomitic Limestone

330

MAP BY ROGER POTTS

SUMMARY OF UNIT WEIGHT CALCULATIONS
BITUMINOUS MIXTURES

- ASSUMPTIONS:
- 1) Solid Volume of Aggregate 0.84 $\frac{\text{cu. ft.}}{\text{cu. ft.}}$
 - 2) Voids in Compacted Mixture 0.04 $\frac{\text{cu. ft.}}{\text{cu. ft.}}$
 - 3) Free Asphalt Content 0.12 $\frac{\text{cu. ft.}}{\text{cu. ft.}}$
 - 4) Asphalt Absorption Equals 2/3 of Water Absorption
 - 5) Limestone and River Sand Blended in a 60-40 Ratio
 - 6) Gravel and River Sand Blended in a 50-50 Ratio

| Area | Aggregate Blends | | | | | |
|---------------------|----------------------------|-----------------|---|------------------|--|-----------------|
| | Limes Course Limes Fine | | Limes Course (60%) River Sand Fine (40%) | | Gravel Course (50%) River Sand Fine (50%) | |
| | lbs/cu.ft. | lbs/sq. yd.-in. | lbs/cu.ft. | lbs/sq. yd. -in. | lbs/cu. ft. | lbs/sq.yd. -in. |
| Central Bluegrass | 148.39 | 111.3 | 146.97* | 110.2* | -- | -- |
| Louisville | 149.14*** | 111.9*** | 147.49 | 110.6 | 145.82 | 109.4 |
| Covington | 144.97 | 108.7 | 145.34 | 109.0 | 145.95 | 109.5 |
| Purchase | 144.97 | 108.7 | 144.89 | 108.7 | 142.38 | 106.8 |
| Portsmouth, Ohio | 144.97 | 108.7 | 144.55 | 108.4 | 143.24 | 107.4 |

* Ohio River Sand From Louisville Area

** Ohio River Sand From Cincinnati Area

*** Dolomitic Ledge-rock

TABLE OF RECOMMENDED UNIT WEIGHTS FOR ESTIMATING QUANTITIES
OF
BITUMINOUS CONCRETE
AND
DENSE-GRADED AGGREGATE BASE

| Aggregate Type | Limestone | | Calcareous* Gravel | Siliceous Gravel | Slag | |
|--------------------------|---------------------|-------------|---------------------|------------------|---------------------|-------------|
| | Bituminous Concrete | D.G.A. Base | Bituminous Concrete | Concrete | Bituminous Concrete | D.G.A. Base |
| Lbs. per cu. ft. | 146.7 | 145.0** | 145.3 | 142.7 | - | - |
| Lbs. per sq. yd. per in. | 110 | 109 | 109 | 107 | - | - |

* Dolomitic

** Based on avg. of in-place test data.

DIVISION OF RESEARCH
SUMMARY OF SPECIFIC GRAVITY OF GRAVELS
April, 1967

| Gravel Source | Size | Bulk Q. D. | Bulk S. S. D. | Appar- ent | Water Absorption |
|---|--------|---------------|------------------|---------------|---------------------|
| Upper Ohio Valley | | | | | |
| *Sturm & Dillard Co., Circleville, Ohio | No. 57 | 2.58 | 2.65 | 2.78 | 2.9 |
| *Sturm & Dillard Co., Circleville, Ohio | No. 8 | 2.53 | 2.61 | 2.76 | 3.3 |
| *Miami Gravel Co., Chillicothe, Ohio | No. 8 | 2.52 | 2.62 | 2.78 | 3.7 |
| *Miami Gravel Co., Chillicothe, Ohio | No. 6 | 2.58 | 2.65 | 2.78 | 2.8 |
| *Standard Slag, Sargent, Ohio | No. 8 | 2.47 | 2.57 | 2.74 | 4.0 |
| *Standard Slag, Sargent, Ohio | No. 6 | 2.52 | 2.59 | 2.71 | 2.8 |
| *Standard Slag, Haverhill, Ohio | No. 8 | 2.47 | 2.53 | 2.62 | 2.3 |
| Portsmouth Sand & Gravel | -- | 2.57 | -- | -- | 1.0 |
| Portsmouth Sand & Gravel | -- | 2.50 | -- | -- | 2.2 |
| Average | | 2.53 | 2.62 | 2.76 | 2.8 |
| Middle Ohio Valley | | | | | |
| *Camp Dennison, Ohio | No. 9 | 2.66 | 2.71 | 2.79 | 1.8 |
| Gravel, Cincinnati, Ohio | -- | -- | 2.69 | -- | -- |
| Miami River Gravel | No. 6 | -- | 2.69 | -- | 1.3 |
| *Ohio Gravel, Newton, Ohio | No. 9 | 2.66 | 2.70 | 2.78 | 1.6 |
| Gravel Cleves, Ohio | -- | -- | 2.69 | -- | -- |
| *Ohio Gravel, Cleves, Ohio | No. 9 | 2.64 | 2.70 | 2.79 | 2.0 |
| Ohio Gravel, Cleves, Ohio | -- | 2.62 | -- | -- | 1.8 |
| *Cooke Aggregate, Petersburg, Ky. | No. 9 | 2.64 | 2.70 | 2.80 | 2.2 |
| Standard Mtls., Burlington, Ky. | No. 9 | 2.61 | 2.65 | 2.72 | 1.6 |
| *Standard Mtls., Belleview, Ky. | No. 9 | 2.60 | 2.66 | 2.77 | 2.4 |
| *Standard Mtls., Belleview, Ky. | No. 9 | 2.64 | 2.69 | 2.77 | 1.8 |
| *Standard Mtls., Belleview, Ky. | No. 6 | 2.64 | 2.69 | 2.78 | 2.8 |
| *Standard Mtls., Warsaw, Ky. | No. 9 | 2.61 | 2.67 | 2.78 | 2.3 |
| *Standard Mtls., Warsaw, Ky. | No. 6 | 2.59 | 2.64 | 2.74 | 2.2 |
| Standard Mtls., Milton, Ky. | No. 9 | 2.58 | 2.64 | 2.74 | 2.2 |
| *Standard Mtls., Carrollton, Ky. | No. 9 | 2.64 | 2.69 | 2.78 | 1.9 |
| *R. W. Greene Co., Louisville, Ky. | No. 6 | 2.66 | 2.70 | 2.78 | 1.6 |
| Ohio River Gravel, Louisville, Ky. | No. 6 | -- | 2.63 | -- | 2.2 |
| *Middle West Rds., Louisville, Ky. | No. 9 | 2.59 | 2.65 | 2.77 | 2.6 |
| Middle West Rds., Louisville, Ky. | No. 9 | 2.56 | 2.63 | 2.73 | 2.4 |
| Middle West Rds., Louisville, Ky. | No. 9 | 2.59 | 2.64 | 2.72 | 1.8 |
| Middle West Rds., Louisville, Ky. | Gravel | | | | |
| | Sand | 2.62 | 2.67 | 2.77 | 2.0 |
| *Standard Mtls., Utica, Indiana | No. 9 | 2.63 | 2.68 | 2.78 | 2.1 |
| Gravel, Louisville | -- | 2.63 | -- | -- | 1.0 |
| Gravel, Louisville | -- | 2.68 | -- | -- | 2.0 |
| Average | | 2.62 | 2.67 | 2.77 | 2.0 |

SUMMARY OF SPECIFIC GRAVITY OF GRAVELS
(Cont'd)

| | | | | | |
|---|------------|------|------|------|-----|
| Columbus-Hickman Area | | | | | |
| *Central States Sand & Gravel Co. | SPR#8 | 2.46 | 2.53 | 2.64 | 2.9 |
| Hickman Sand & Gravel Co., Hickman, Ky. | No. 9 | 2.48 | 2.55 | 2.66 | 2.7 |
| Hickman Sand & Gravel Co., Hickman, Ky. | Cr. Gravel | | | | |
| | Sand | 2.53 | 2.59 | 2.70 | 2.4 |
| Average | | 2.49 | 2.56 | 2.67 | 2.7 |
| Henderson & Owensboro Areas | | 2.45 | -- | -- | 3.0 |
| Henderson & Owensboro Areas | | 2.51 | -- | -- | 2.4 |
| Henderson & Owensboro Areas | | -- | 2.62 | -- | -- |

*Denotes those gravels sampled by Materials Division personnel, submitted to the Research Division for testing.

DIVISION OF RESEARCH
SUMMARY OF SPECIFIC GRAVITY DATA
OHIO RIVER SAND
April, 1967

| Aggregate Source | Specific Gravity | | | Water Absorption (%) |
|------------------|------------------|---------------|----------|----------------------|
| | Bulk O. D. | Bulk S. S. D. | Apparent | |
| Zone 1 | 2.59 | 2.62 | 2.68 | 1.3 |
| | 2.56 | 2.60 | 2.67 | 1.6 |
| | 2.60 | 2.63 | 2.68 | 1.1 |
| | 2.59 | 2.61 | 2.65 | 0.9 |
| | 2.55 | -- | -- | 0.8 |
| | 2.56 | 2.61 | 2.69 | 1.8 |
| Average | 2.58 | 2.61 | 2.67 | 1.3 |
| Zone 2 | 2.62 | 2.66 | 2.73 | 1.6 |
| | 2.61 | 2.65 | 2.72 | 1.5 |
| | 2.62 | 2.65 | 2.70 | 1.1 |
| | 2.64 | 2.66 | 2.71 | 1.0 |
| | 2.62 | 2.67 | 2.73 | 1.5 |
| | 2.62 | 2.66 | 2.73 | 1.6 |
| | 2.64 | 2.68 | 2.72 | 1.1 |
| | 2.63 | 2.66 | 2.72 | 1.2 |
| | 2.62 | 2.66 | 2.74 | 1.8 |
| | -- | 2.65 | -- | 1.0 |
| | -- | 2.67 | -- | 1.0 |
| | -- | 2.63 | -- | -- |
| | 2.56 | 2.62 | 2.74 | 2.6 |
| Average | 2.62 | 2.66 | 2.72 | 1.4 |
| Zone 3 | 2.60 | 2.64 | 2.69 | 1.3 |
| | 2.61 | 2.64 | 2.70 | 1.2 |
| | 2.62 | 2.65 | 2.69 | 1.1 |
| | 2.60 | 2.63 | 2.69 | 1.3 |
| | 2.62 | 2.65 | 2.70 | 1.2 |
| | 2.58 | 2.62 | 2.69 | 1.6 |
| | 2.57 | 2.62 | 2.70 | 1.9 |
| | 2.61 | 2.65 | 2.71 | 1.4 |
| | 2.59 | 2.63 | 2.69 | 1.4 |
| | 2.58 | 2.63 | 2.71 | 1.9 |
| | 2.63 | 2.66 | 2.71 | 1.1 |
| | -- | 2.66 | -- | 1.0 |
| | -- | 2.63 | -- | 1.0 |
| 2.62 | 2.65 | -- | 1.07 | |

SUMMARY OF SPECIFIC GRAVITY DATA
OHIO RIVER SAND
(Cont'd)

| | | | | |
|--------|---------|------|------|------|
| Zone 3 | 2.63 | 2.64 | 2.66 | 0.5 |
| | 2.64 | 2.65 | -- | 0.6 |
| | 2.62 | 2.64 | 2.67 | 0.9 |
| | 2.58 | 2.62 | 2.68 | 1.3 |
| | 2.59 | 2.62 | 2.66 | 1.1 |
| | 2.58 | 2.62 | 2.68 | 1.4 |
| | 2.60 | 2.63 | 2.68 | 1.1 |
| | 2.60 | 2.62 | 2.67 | 1.0 |
| | 2.59 | 2.61 | 2.66 | 1.2 |
| | 2.62 | 2.64 | 2.67 | 0.8 |
| | 2.62 | 2.65 | 2.70 | 1.1 |
| | 2.62 | 2.64 | 2.70 | 1.1 |
| | Average | 2.60 | 2.64 | 2.69 |

Zone (1) West Mason County Line and Above (Portsmouth Area)

Zone (2) West Trimble County Line to West Mason County Line (Cincinnati Area)

Zone (3) West Trimble County Line and All West (Louisville & Henderson Area)

DIVISION OF RESEARCH
SUMMARY OF SPECIFIC GRAVITY DATA: LIMESTONE AGGREGATE
May, 1967

| Aggregate Source | Size | Specific Gravity | | | Water Absorp- tion % |
|---|------------|------------------|------------------|---------------|-------------------------------|
| | | Bulk O. D. | Bulk S. S. D. | Appar- ent | |
| Central Rock Co., Lexington, Ky. | No. 9 | 2.65 | 2.67 | 2.71 | 0.8 |
| | " | 2.67 | 2.70 | 2.75 | 1.0 |
| | -- | 2.68 | -- | -- | 0.3 |
| | -- | 2.70 | -- | -- | 0.6 |
| | No. 3 | -- | 2.74 | -- | 0.5 |
| | No. 6 | -- | 2.73 | -- | 0.6 |
| | -- | -- | 2.70 | -- | -- |
| | -- | -- | 2.70 | -- | -- |
| | -- | 2.73 | 2.74 | 2.77 | 0.5 |
| | No. 6 | 2.73 | 2.74 | 2.77 | 0.6 |
| | No. 6 | 2.72 | 2.74 | -- | -- |
| | No. 6 | 2.72 | 2.73 | 2.75 | 0.5 |
| | 1" - 3/4" | 2.71 | 2.72 | 2.72 | 0.3 |
| | 1/2 - 3/4" | 2.71 | 2.72 | 2.73 | 0.2 |
| | No. 6 | 2.71 | 2.72 | 2.74 | 0.4 |
| | No. 6 | 2.72 | 2.73 | 2.76 | 0.5 |
| | -- | 2.70 | 2.71 | -- | 0.5 |
| Limes. Sand | 2.64 | 2.68 | 2.75 | 1.5 | |
| Avg. | 2.70 | 2.72 | 2.745 | 0.58 | |
| Kentucky Stone Co., Boonesboro, Ky. Madison County | No. 9 | 2.68 | 2.71 | 2.75 | 0.9 |
| | No. 9 | 2.65 | 2.66 | 2.69 | 1.1 |
| | Lime S. | 2.65 | 2.69 | 2.74 | 1.2 |
| | L.S. | 2.65 | 2.69 | 2.76 | 1.5 |
| | L.S. | 2.65 | 2.68 | 2.74 | 1.3 |
| | No. 9 | 2.65 | 2.69 | 2.75 | 1.4 |
| | L.S. | -- | -- | -- | -- |
| | Avg. | 2.655 | 2.69 | 2.738 | 1.2 |
| Franklin County Stone Co. Franklin County | No. 9 | 2.67 | 2.69 | 2.73 | 0.8 |
| | No. 9 | 2.68 | 2.70 | 2.73 | 0.8 |
| | L.S. | 2.61 | 2.66 | 2.74 | 0.9 |
| | L.S. | 2.50 | 2.60 | 2.77 | 3.9 |
| | L.S. | 2.57 | 2.63 | 2.75 | 2.6 |
| | Avg. | 2.61 | 2.66 | 2.744 | 1.8 |
| Clark County | 1/2-No. 4 | 2.71 | 2.72 | 2.75 | 0.6 |
| | No. 4-Dust | 2.67 | 2.70 | 2.77 | 1.4 |
| | Avg. | 2.69 | 2.71 | 2.76 | 1.0 |

SUMMARY OF SPECIFIC GRAVITY DATA LIMESTONE AGGREGATE
(Cont'd)

| | | | | | |
|--|------------|------|------|------|-----|
| Oregon & Tyrone Formations | -- | 2.70 | 2.72 | 2.75 | 0.5 |
| Bourbon County Stone Co. | No. 9 | 2.64 | 2.67 | 2.72 | 1.1 |
| | No. 9 | 2.64 | 2.67 | 2.72 | 1.2 |
| | L.S. | 2.61 | 2.66 | 2.74 | 1.8 |
| | Avg. | 2.63 | 2.67 | 2.73 | 1.4 |
| Caldwell Stone Co., Danville, Ky. Boyle County | No. 9 | 2.66 | 2.67 | 2.68 | 0.3 |
| | 1/2-No. 4 | 2.69 | 2.70 | 2.72 | 0.4 |
| | L.S. | 2.65 | 2.69 | 2.70 | 0.7 |
| | Avg. | 2.67 | 2.69 | 2.70 | 0.5 |
| Average - Central Bluegrass Limestone | | 2.67 | 2.69 | 2.74 | 1.0 |
| Acme Stone Co., Olive Hill Carter Co. | No. 9 | 2.63 | 2.65 | 2.69 | 0.8 |
| | No. 9 | 2.68 | 2.70 | 2.74 | 1.0 |
| | -- | 2.61 | -- | 2.73 | -- |
| | L.S. | 2.58 | 2.63 | 2.72 | 2.0 |
| | L.S. | 2.57 | 2.63 | 2.72 | 2.2 |
| | Avg. | 2.61 | 2.65 | 2.72 | 1.5 |
| A. W. Walker, Frenchburg, Ky. Menifée County | No. 9 | 2.67 | 2.69 | 2.72 | 0.8 |
| | L.S. | 2.59 | 2.64 | 2.73 | 1.9 |
| | Avg. | 2.52 | 2.67 | 2.73 | 1.4 |
| Waters Const., Co., Hardin Co. | No. 9 | 2.58 | 2.64 | 2.74 | 2.4 |
| | L.S. | 2.45 | 2.55 | 2.72 | 4.1 |
| | Avg. | 2.52 | 2.60 | 2.73 | 3.3 |
| Hardin Co. | 1/2-No. 4 | 2.53 | 2.61 | 2.75 | 3.1 |
| | No. 4-Dust | 2.42 | 2.54 | 2.73 | 4.7 |
| | Avg. | 2.48 | 2.58 | 2.74 | 3.9 |
| Ky. Stone Co. -Upton, Ky. Hardin County | No. 9 | 2.62 | 2.64 | 2.68 | 0.9 |
| | L. S. | 2.65 | 2.68 | 2.73 | 1.1 |
| | Avg. | 2.64 | 2.66 | 2.70 | 1.0 |
| Geoghegan & Mathis, Butler, Ky. Pendleton, County | No. 9 | 2.67 | 2.69 | 2.73 | 0.8 |
| | L. S. | 2.57 | 2.63 | 2.72 | 2.1 |
| | L. S. | 2.57 | 2.63 | 2.75 | 2.8 |
| | L. S. | 2.56 | 2.62 | 2.74 | 2.6 |
| | Avg. | 2.59 | 2.64 | 2.74 | 2.1 |

SUMMARY OF SPECIFIC GRAVITY DATA LIMESTONE AGGREGATE
(Cont'd)

| | | | | | |
|--|------------|------|------|------|-----|
| White Stone Co., Hardinsburg, Ky. Breckenridge County | No. 9 | 2.51 | 2.58 | 2.70 | 2.9 |
| | L.S. | 2.53 | 2.60 | 2.74 | 3.1 |
| | Avg. | 2.52 | 2.59 | 2.72 | 3.0 |
| Kemp Stone Co. | No. 9 | 2.63 | 2.66 | 2.72 | 1.3 |
| | L.S. | 2.60 | 2.64 | 2.73 | 2.0 |
| | Avg. | 2.62 | 2.65 | 2.73 | 1.7 |
| Greenville Quarry Muhlenburg Co. | | 2.64 | 2.67 | 2.71 | 0.9 |
| Hopkinsville Stone Co. Christian County | No. 9 | 2.56 | 2.61 | 2.69 | 1.9 |
| | -- | 2.69 | 2.71 | 2.75 | 0.9 |
| | No. 9 | 2.64 | 2.67 | 2.72 | 0.9 |
| | L.S. | 2.58 | 2.63 | 2.72 | 1.9 |
| | L.S. | 2.56 | 2.63 | 2.75 | 2.7 |
| | L.S. | 2.57 | 2.63 | 2.73 | 2.2 |
| | Avg. | 2.60 | 2.65 | 2.73 | 1.8 |
| Licking River Stone Co. Morgan County | No. 9 | 2.66 | 2.68 | 2.71 | 0.7 |
| | L.S. | 2.58 | 2.62 | 2.69 | 1.6 |
| | Avg. | 2.62 | 2.65 | 2.70 | 1.2 |
| Shamrock Stone Co. Adair County or Clinton County | No. 9 | 2.64 | 2.66 | 2.71 | 1.0 |
| | L.S. | 2.56 | 2.63 | 2.74 | 2.5 |
| | Avg. | 2.60 | 2.65 | 2.73 | 1.8 |
| Pace Quarry, Glasgow Barren County | No. 9 | 2.63 | 2.67 | 2.73 | 1.4 |
| | L.S. | 2.62 | 2.65 | 2.72 | 1.5 |
| | Avg. | 2.63 | 2.66 | 2.73 | 1.5 |
| Gary Brothers, Bowling Green Warren County | No. 9 | 2.66 | 2.68 | 2.71 | 0.7 |
| | L.S. | 2.56 | 2.62 | 2.71 | 2.3 |
| | Avg. | 2.61 | 2.65 | 2.71 | 1.5 |
| Casey County Stone Co. Casey County | 1/2-No. 4 | 2.64 | 2.68 | 2.74 | 1.4 |
| | No. 4-Dust | 2.51 | 2.60 | 2.76 | 3.6 |
| | Avg. | 2.58 | 2.64 | 2.75 | 2.5 |
| Average - Undifferentiated Limestones | | 2.59 | 2.64 | 2.72 | 1.9 |
| Jefferson County Stone Co., Avoco, Ky. Jefferson Co. | No. 9 | 2.65 | 2.71 | 2.82 | 1.7 |
| | -- | 2.68 | -- | 2.85 | -- |
| | L.S. | 2.70 | 2.75 | 2.84 | 1.7 |
| | Avg. | 2.68 | 2.73 | 2.84 | 1.7 |

SUMMARY OF SPECIFIC GRAVITY DATA LIMESTONE AGGREGATE
(Cont'd)

| | | | | | |
|--|------------|------|------|------|------|
| Ohio River Stone Co. Oldham County | No. 9 | 2.61 | 2.67 | 2.78 | 2.3 |
| | L.S. | 2.77 | 2.80 | 2.85 | 0.1 |
| | Avg. | 2.69 | 2.74 | 2.82 | 1.2 |
| Louisville Crushed Stone Jefferson County | No. 36 | 2.73 | 2.75 | -- | 1.04 |
| | | | | | |
| Jefferson & Oldham Cos. Louisville | 2-1/2-1/4" | -- | 2.77 | -- | -- |
| | No. 11 | 2.65 | 2.71 | 2.83 | 2.4 |
| | L.S. | 2.62 | 2.70 | 2.84 | 2.9 |
| | Avg. | 2.64 | 2.71 | 2.84 | 2.6 |
| Geoghegan & Mathis Nelson County | -- | 2.63 | 2.69 | 2.80 | 2.3 |
| | | | | | |
| Average Dolomitic Limestone | | 2.67 | 2.72 | 2.83 | 1.8 |

DIVISION OF MATERIALS
SUMMARY OF UNIT WEIGHTS DENSE-GRADED AGGREGATE
1965 and 1966 Test Results

| County | Project No. | Source | Unit Weight (Bulk O. D.) | Specific Gravity |
|---------|--------------|--------------------------------------|--------------------------|------------------|
| Barren | SU 237-2 | J. F. Pace Glasgow, Ky. | 143.2 | 2.64 |
| Bath | I 64-6(6)117 | A. W. Walker & Son Mt. Sterling, Ky. | 146.3 | 2.65 |
| | | | 148.1 | |
| Bell | APD 151(18) | Ky. -Va. Stone Co. | 149.6 | 2.71 |
| | | | 154.8 | |
| | | | 153.7 | |
| | | | 150.3 | |
| Fayette | U 174(11) | Central Rock Co. | 139.2 | 2.62 |
| | | | 141.9 | |
| Fayette | U 538(27) | Ky. Stone Co. | 141.0 | 2.66 |
| | | | 145.9 | |
| | | | 140.2 | |
| | | | 144.1 | |
| | | | 140.9 | |
| | | | 141.4 | |
| | | | 142.2 | |
| | | | 143.2 | |
| | | | 141.5 | |
| | | | 140.5 | |
| | | | 145.8 | |
| | | | 145.9 | |
| | | | 144.7 | |
| | | | 142.6 | |
| | | | 145.6 | |
| | | | 144.9 | |
| | | | 143.8 | |
| | | | 137.6 | |
| | | | 139.1 | |
| | | | 133.4 | |
| | | | 143.5 | |
| | | | 144.6 | |
| | | | 151.7 | |
| | | | 142.5 | |
| | | | 146.2 | |
| | | | 142.0 | |
| | | | 142.1 | |
| | | | 140.2 | |
| | | | 135.7 | |
| | | | 136.9 | |
| | | | 141.9 | |
| | | | 138.0 | |
| | | | 142.4 | |

SUMMARY OF UNIT WEIGHTS DENSE GRADED AGGREGATE
(Cont'd)

| | | | | |
|---------|-----------|---------------|-------|------|
| Fayette | U 538(27) | Ky. Stone Co. | 142.0 | 2.66 |
| | | | 149.7 | |
| | | | 139.2 | |
| | | | 136.3 | |
| | | | 138.0 | |
| | | | 142.3 | |
| | | | 142.5 | |
| | | | 143.0 | |
| | | | 145.6 | |
| | | | 139.1 | |
| | | | 137.7 | |
| | | | 143.8 | |
| | | | 143.7 | |
| | | | 144.4 | |
| | | | 143.6 | |
| | | | 142.3 | |
| | | | 146.5 | |
| | | | 140.9 | |
| | | | 140.3 | |
| | | | 147.1 | |
| | | | 144.8 | |
| | | | 146.0 | |
| | | | 138.8 | |
| | | | 137.0 | |
| | | | 146.4 | |
| | | | 143.1 | |
| | | | 141.4 | |
| | | | 142.9 | |
| | | | 152.9 | |
| | | | 149.5 | |
| | | | 152.1 | |
| | | | 140.5 | |
| | | | 145.0 | |
| | | | 144.5 | |
| | | | 144.1 | |
| | | | 144.1 | |
| | | | 144.9 | |
| | | | 138.7 | |
| | | | 139.4 | |
| | | | 145.0 | |
| | | | 145.1 | |
| | | | 146.3 | |

SUMMARY OF UNIT WEIGHTS DENSE GRADED AGGREGATE
(Cont'd)

| | | | | |
|----------|-------------|-------------------------------------|-------|------|
| Fayette | U 538(27) | Ky. Stone Co. | 144.5 | 2.66 |
| | | | 145.6 | |
| | | | 147.3 | |
| | | | 142.0 | |
| | | | 152.3 | |
| | | | 142.3 | |
| | | | 142.8 | |
| | | | 146.6 | |
| | | | 145.4 | |
| | | | 142.9 | |
| Franklin | F 266(11) | Falls City Stone #1, Frankfort Ky. | 143.6 | 2.68 |
| | | | 149.1 | |
| | | | 145.8 | |
| | | | 151.1 | |
| | | | 145.5 | |
| | | | 143.1 | |
| | | | 148.7 | |
| | | | 143.6 | |
| | | | 143.9 | |
| | | | 141.7 | |
| Franklin | F 172(15) | Falls City Stone #1, Frankfort, Ky. | 143.2 | 2.68 |
| | | | 143.6 | |
| Harlan | APD 151(19) | Nally & Boone | 140.5 | 2.67 |
| | | | 145.4 | |
| | | | 151.9 | |
| | | | 149.1 | |
| | | | 141.9 | |
| | | | 145.8 | |
| | | | 147.3 | |
| | | | 154.0 | |
| | | | 148.6 | |
| | | | 158.0 | |
| | | | 154.3 | |
| | | | 152.8 | |
| | | | 147.6 | |
| | | | 146.6 | |
| | | | 144.3 | |
| | | | 148.3 | |
| | | | 146.0 | |
| 159.7 | | | | |
| 153.3 | | | | |
| 152.5 | | | | |
| 143.1 | | | | |

SUMMARY OF UNIT WEIGHTS DENSE GRADED AGGREGATE
(Cont'd)

| | | | | |
|----------|-------------|--------------------|-------|------|
| Harlan | APD 151(19) | Nally & Boone | 140.5 | 2.67 |
| | | | 144.0 | |
| | | | 142.4 | |
| | | | 141.5 | |
| | | | 147.2 | |
| | | | 141.8 | |
| | | | 145.6 | |
| | | | 152.1 | |
| | | | 146.1 | |
| | | | 147.9 | |
| | | | 142.7 | |
| | | | 152.6 | |
| | | | 147.7 | |
| | | | 154.0 | |
| | | | 133.3 | |
| | | | 146.4 | |
| | | | 147.1 | |
| | | | 150.2 | |
| | | | 144.3 | |
| | | | 140.2 | |
| | | | 140.1 | |
| | | | 137.9 | |
| | | | 143.0 | |
| | | | 149.3 | |
| | | | 146.8 | |
| | | | 162.0 | |
| | | | 149.3 | |
| | | | 149.6 | |
| | | | 151.9 | |
| | | | 145.8 | |
| | | | 145.5 | |
| | | | 141.0 | |
| | | | 140.5 | |
| | | | 145.8 | |
| | | | 154.5 | |
| | | | 148.8 | |
| | | | 140.6 | |
| | | | 150.1 | |
| | | | 142.5 | |
| Lawrence | APD 537(18) | Standard Slag. Co. | 138.1 | 2.33 |
| | | | 138.1 | |
| | | | 119.8 | |

SUMMARY OF UNIT WEIGHTS DENSE GRADED AGGREGATE
(Cont'd)

| | | | | |
|----------|-------------|--------------------|-------|------|
| Lawrence | APD 537(18) | Standard Slag. Co. | 122.3 | 2.33 |
| | | | 128.8 | |
| | | | 126.3 | |
| | | | 131.2 | |
| | | | 123.0 | |
| | | | 124.5 | |
| | | | 124.8 | |
| | | | 126.8 | |
| | | | 129.2 | |
| | | | 125.0 | |
| | | | 122.0 | |
| | | | 131.1 | |
| | | | 132.8 | |
| | | | 124.9 | |
| | | | 117.1 | |
| | | | 138.1 | |
| | | | 132.9 | |
| | | | 130.1 | |
| | | | 139.2 | |
| | | | 131.5 | |
| | | | 128.0 | |
| | | | 132.3 | |
| | | | 126.2 | |
| | | | 132.8 | |
| | | | 134.1 | |
| | | | 129.0 | |
| | | | 123.5 | |
| | | | 134.7 | |
| | | | 133.2 | |
| | | | 130.4 | |
| | | | 128.9 | |
| | | | 124.3 | |
| | | | 124.8 | |
| | | | 128.5 | |
| | | | 132.0 | |
| | | | 129.9 | |
| | | | 124.2 | |
| | | | 122.5 | |
| | | | 127.5 | |
| | | | 132.0 | |
| | | | 127.8 | |
| | | | 130.8 | |

SUMMARY OF UNIT WEIGHTS DENSE GRADED AGGREGATE
(Cont'd)

| | | | | |
|----------|-------------|--------------------|-------|------|
| Lawrence | APD 537(18) | Standard Slag. Co. | 129.9 | 2.33 |
| | | | 129.9 | |
| | | | 129.8 | |
| | | | 129.4 | |
| | | | 122.6 | |
| | | | 132.0 | |
| | | | 129.8 | |
| | | | 136.9 | |
| | | | 126.3 | |
| | | | 125.7 | |
| | | | 129.4 | |
| | | | 126.3 | |
| | | | 125.0 | |
| | | | 125.0 | |
| | | | 127.5 | |
| Lawrence | S 431(7) | Standard Slag. Co. | 120.3 | |
| | | | 123.6 | |
| | | | 136.5 | |
| | | | 135.1 | |
| | | | 133.3 | |
| | | | 130.5 | |
| | | | 125.1 | |
| | | | 131.1 | |
| | | | 124.4 | |
| | | | 128.6 | |
| | | | 122.7 | |
| | | | 139.8 | |
| Lawrence | F 133(19) | Standard Slag. Co. | 128.7 | 2.33 |
| Lawrence | APD 133(19) | Standard Slag. Co. | 133.6 | |
| | | | 131.8 | |
| | | | 127.4 | |
| | | | 130.2 | |
| | | | 129.2 | |
| | | | 137.6 | |
| | | | 129.4 | |
| | | | 136.9 | |
| | | | 127.5 | |
| | | | 129.4 | |
| | | | 138.2 | |
| | | | 128.7 | |
| | | | 115.0 | |
| | | | 132.4 | |

SUMMARY OF UNIT WEIGHTS DENSE GRADED AGGREGATE
(Cont'd)

| | | | | |
|---------|----------|--------------|-------|------|
| Madison | S 616(7) | Allen County | 143.1 | 2.69 |
| | | | 143.0 | |
| | | | 149.0 | |
| | | | 146.0 | |
| | | | 147.8 | |
| | | | 154.5 | |
| | | | 148.0 | |
| | | | 145.1 | |
| | | | 148.0 | |
| | | | 145.1 | |
| | | | 150.0 | |
| | | | 148.1 | |
| | | | 151.8 | |
| | | | 150.0 | |
| | | | 148.1 | |
| | | | 151.8 | |
| | | | 139.6 | |
| | | | 135.2 | |
| | | | 151.2 | |
| | | | 151.8 | |
| | | | 147.2 | |
| | | | 151.0 | |
| | | | 141.0 | |
| | | | 143.0 | |
| | | | 142.0 | |
| | | | 148.0 | |
| | | | 148.5 | |
| | | | 151.4 | |
| | | | 146.7 | |
| | | | 154.0 | |
| | | | 143.5 | |
| | | | 141.0 | |
| | | | 156.0 | |
| | | | 147.8 | |
| | | | 146.0 | |
| | | | 153.0 | |
| | | | 156.0 | |
| | | | 154.1 | |
| | | | 146.1 | |
| | | | 150.2 | |
| | | | 150.0 | |
| | | | 140.9 | |
| | | | 150.0 | |
| | | | 152.0 | |

SUMMARY OF UNIT WEIGHTS DENSE GRADED AGGREGATE
(Cont'd)

| | | | | |
|-----------|-----------------------|---|--|--------------|
| Madison | S 616(7) | Allen County | 152.5 149.0 147.1 145.8 | 2.69 |
| Perry | APD 102(43) | Adams Const. Co., Ky. Stone Co. Yellow Rock, Ky. | 140.6 150.9 | 2.66 |
| Perry | APD 103(43) | Adams Const. Co., Ky. Stone Co. Yellow Rock, Ky. | 145.2 148.7 140.1 146.1 147.6 147.3 147.5 140.5 | |
| Scott | SU 291(4) S 291(4) | Nally & Gibson | 146.2 | 2.65 |
| Jefferson | F 552(10) | Falls City Stone Co., Fern Creek, Ky. | 137.7 | 2.60 |
| Jefferson | I 71-1(14)1 | Falls City Stone Co., Fern Creek, Ky. | 141.3 | 2.65 |
| Jefferson | I 71-1(16)7 | Falls City Stone #6 Prospect, Ky. | 143.9 | 2.65 |
| Jefferson | I 71-1(17)10 | Falls City Stone #5 Fern Creek, Ky. | 147.7 | 2.65 |
| Warren | I 65-1(14)22 | McLellan Stone Co. | 139.9 138.1 136.6 139.7 136.8 137.1 140.3 | 2.59 |
| Jefferson | I 71-1(18)0 | Louisville Crushed Stone | 139.4 141.3 143.0 139.5 145.3 | 2.69 |
| Jefferson | I 71-1(14)1 | Source not known | 140.5 132.5 140.8 141.7 141.6 140.5 140.9 | 2.65 2.66 |

SUMMARY OF UNIT WEIGHTS DENSE GRADED AGGREGATE
(Cont'd)

| | | | | |
|----------|-----------------|------------------|-------|------|
| Allen | R. S. 2-145-1C1 | Source not known | 139.2 | 2.59 |
| Franklin | F 172(15) | Source not known | 143.8 | 2.68 |
| | | | 140.8 | |
| | | | 143.0 | |
| | | | 142.2 | |
| | | | 141.2 | |
| | | | 141.3 | |

BITUMINOUS CONCRETE DENSITY DATA
DIVISION OF MATERIALS

(From Active Project Files)

| County | Project No. | Type & Aggregate Blend | Unit Weight | Percent of Solid Density |
|-----------|-------------|--------------------------------------|-------------|--------------------------|
| Barren | SU 237-2 | Surf. (60% Limes., 40% Nat. Sand) | 146.6 | 93.3 |
| " | " | " | 140.4 | 90.0 |
| " | " | " | 132.3 | 84.8 |
| " | " | " | 135.4 | 86.6 |
| " | " | " | 137.9 | 88.4 |
| " | " | Base (100% Limes.) | 142.3 | 90.1 |
| " | " | " | 144.1 | 91.3 |
| " | " | " | 146.0 | 92.5 |
| " | " | " | 147.9 | 93.7 |
| " | " | " | 146.6 | 92.9 |
| " | " | " | 142.3 | 90.1 |
| " | " | " | 142.9 | 90.5 |
| " | " | " | 143.5 | 90.9 |
| Bath | I64-6(6)117 | Surf. (60% Limes., 40% Nat. Sand) | 138.5 | 91.4 |
| " | " | Base (100% Limes.) | 147.3 | 94.8 |
| Bell | APD 151(18) | Surf. (60% Limes., 40% Nat. Sand) | 137.3 | 89.4 |
| " | " | " | 145.4 | 94.7 |
| " | " | " | 141.7 | 92.3 |
| " | " | " | 141.7 | 92.3 |
| " | " | Base (100% Limes.) | 148.5 | 96.0 |
| " | " | " | 137.9 | 89.1 |
| " | " | " | 146.6 | 94.8 |
| " | " | " | 150.5 | 97.2 |
| " | " | " | 147.4 | 95.3 |
| Breathitt | APD 102(44) | Surf (60% Limes., 40% Nat. Sand) | 136.0 | 90.0 |
| " | " | " | 134.2 | 88.8 |
| " | " | " | 137.5 | 91.0 |
| " | " | " | 133.5 | 88.4 |
| " | " | Binder (100% Limes.) | 141.9 | 90.6 |

BITUMINOUS CONCRETE DENSITY DATA
DIVISION OF MATERIALS

(From Active Project Files)
(Cont'd)

| | | | | |
|-----------|-------------|-----------------------------|-------|------|
| Breathitt | APD 102(44) | Binder | 131.6 | 84.0 |
| | | (100% Limes.) | | |
| " | " | " | 145.9 | 93.1 |
| " | " | " | 142.4 | 90.9 |
| Fayette | U 174(11) | Surf. | 137.3 | 88.7 |
| | | (60% Limes., 40% Nat. Sand) | | |
| " | " | " | 145.4 | 94.3 |
| " | " | " | 140.4 | 91.1 |
| " | " | " | 142.9 | 92.7 |
| " | " | " | 143.5 | 93.1 |
| " | " | " | 145.4 | 94.0 |
| " | " | " | 140.4 | 90.7 |
| " | " | " | 142.9 | 92.3 |
| " | " | " | 143.5 | 92.7 |
| " | " | Base | 147.3 | 94.8 |
| | | (100% Limes.) | | |
| " | " | " | 148.5 | 95.6 |
| " | " | " | 147.9 | 95.2 |
| " | " | " | 147.3 | 95.2 |
| Fayette | U 538(27) | Surf. | 132.3 | 86.5 |
| | | (60% Limes., 40% Nat. Sand) | | |
| " | " | " | 136.0 | 89.0 |
| " | " | " | 134.8 | 88.5 |
| " | " | " | 136.0 | 89.3 |
| " | " | " | 134.8 | 88.5 |
| " | " | " | 138.5 | 91.0 |
| " | " | " | 127.3 | 83.6 |
| " | " | " | 136.0 | 89.3 |
| " | " | Base | 145.4 | 94.3 |
| | | (100% Limes.) | | |
| " | " | " | 146.0 | 94.7 |
| " | " | " | 149.8 | 97.2 |
| " | " | " | 146.0 | 94.7 |
| " | " | " | 147.3 | 95.5 |
| " | " | " | 142.3 | 92.3 |
| " | " | " | 144.8 | 93.9 |
| " | " | " | 147.3 | 95.5 |
| " | " | " | 147.3 | 95.5 |
| " | " | " | 143.5 | 93.1 |
| " | " | " | 147.9 | 95.9 |

BITUMINOUS CONCRETE DENSITY DATA
DIVISION OF MATERIALS

(From Active Project Files)
(Cont'd)

| | | | | |
|----------|-------------|-----------------------------|-------|------|
| Fayette | U 538(27) | Base | 149.8 | 97.2 |
| | | (100% Limes.) | | |
| " | " | " | 145.4 | 94.3 |
| " | " | " | 149.1 | 96.8 |
| " | " | " | 146.0 | 94.7 |
| " | " | " | 143.5 | 93.1 |
| " | " | " | 144.8 | 93.9 |
| " | " | " | 144.1 | 93.5 |
| " | " | " | 146.0 | 94.7 |
| " | " | " | 137.9 | 89.5 |
| " | " | " | 144.1 | 93.5 |
| " | " | " | 147.3 | 95.5 |
| " | " | " | 142.3 | 92.3 |
| " | " | " | 144.8 | 93.9 |
| " | " | " | 147.3 | 95.5 |
| " | " | " | 145.4 | 94.3 |
| " | " | " | 148.5 | 95.2 |
| " | " | " | 145.4 | 93.2 |
| " | " | " | 142.9 | 91.6 |
| Franklin | F 226(11) | Base | 148.5 | 95.3 |
| | | (100% Limes.) | | |
| " | " | " | 142.6 | 91.5 |
| Harlan | APD 151(19) | Surf. | 141.0 | 92.2 |
| | | (60% Limes., 40% Nat. Sand) | | |
| " | " | " | 134.8 | 88.2 |
| " | " | " | 137.3 | 89.8 |
| " | " | " | 137.3 | 89.8 |
| " | " | " | 137.3 | 89.8 |
| " | " | " | 142.3 | 93.0 |
| " | " | " | 139.2 | 91.0 |
| " | " | " | 139.2 | 91.0 |
| " | " | " | 137.3 | 89.8 |
| " | " | Base | 147.3 | 95.2 |
| | | (100% Limes.) | | |
| " | " | " | 146.6 | 94.8 |
| " | " | " | 147.3 | 94.8 |
| " | " | " | 149.1 | 96.4 |
| " | " | " | 145.4 | 94.0 |
| " | " | " | 145.2 | 93.8 |

BITUMINOUS CONCRETE DENSITY DATA
DIVISION OF MATERIALS

(From Active Project Files)
(Cont'd)

| | | | | |
|----------|--------------------------|--|-------|------|
| Lawrence | APD 537(18), APD 133(19) | Surf.(Slag) | 129.5 | 90.1 |
| | | (60% Slag, 40% Nat. Sand) | | |
| " | " | " | 129.3 | 90.1 |
| " | " | " | 126.0 | 86.3 |
| " | " | Base | 157.9 | |
| | | (60% Slag, 20% limes. Sand, 20 Nat. Sand) | | |
| " | " | " | 157.9 | |
| " | " | " | 160.4 | |
| " | " | " | 154.8 | |
| " | " | " | 160.4 | |
| Madison | S 616(7) | Surf. | 139.8 | 91.4 |
| | | (60% Limes., 40% Nat. Sand) | | |
| " | " | " | 141.0 | 92.2 |
| " | " | " | 136.7 | 89.4 |
| " | " | " | 138.5 | 90.6 |
| " | " | Base | 146.6 | 86.4 |
| | | (100% Limes.) | | |
| " | " | " | 149.8 | 88.2 |
| " | " | " | 150.4 | 88.6 |
| " | " | " | 149.1 | 87.9 |
| Perry | APD 102(43) | Base | 145.8 | 95.4 |
| | | (100% Limes.) | | |
| " | " | " | 144.1 | 94.3 |
| " | " | " | 147.1 | 96.2 |
| " | " | " | 146.9 | 96.1 |
| Scott | SU 291(4) | Surf. | 136.0 | 80.0 |
| " | " | (60% Limes., 40% Nat.) | | |
| " | " | Base | 149.8 | 97.2 |
| | | (100% Limes.) | | |

DIVISION OF RESEARCH
SUMMARY CORE DENSITIES FOR RECONSTRUCTED
US 60 AT OLIVE HILL, KENTUCKY, PROJECT FFG 13(8)
April, 1967

| Core No. | Density (lbs/cu. ft.) | Core No. | Density (lbs/cu. ft.) |
|--------------------|-----------------------|-----------------------|-----------------------|
| Bottom Base Course | | 501 | 149.7 |
| | | 502 | 148.9 |
| 101 | 145.6 | 503 | 149.4 |
| 102 | 146.0 | Avg. | 149.3 |
| 103 | 146.3 | | |
| Avg. | 146.0 | 5I1 | 148.4 |
| | | 5I2 | 148.6 |
| 1I1 | 141.8 | 5I3 | 149.5 |
| 1I2 | 143.9 | Avg. | 148.8 |
| 1I3 | 142.9 | | |
| Avg. | 142.9 | 5B1 | 148.8 |
| | | 5B2 | 142.6 |
| 1B1 | 147.1 | 5B3 | 149.5 |
| 1B2 | 144.8 | Avg. | 147.0 |
| 1B3 | --- | | |
| Avg. | 146.0 | Avg. Sect. 5 - | 147-4 |
| Avg. Sect. 1 - | 145.0 | 801 | 149.2 |
| | | 802 | 150.5 |
| 401 | 146.7 | 803 | 151.6 |
| 402 | 151.7 | Avg. | 150.5 |
| 403 | 148.8 | | |
| Avg. | 149.1 | 8I1 | 149.0 |
| | | 8I2 | 152.2 |
| 4I1 | 151.0 | 8I3 | 145.9 |
| 4I2 | 153.1 | Avg. | 149.0 |
| 4I3 | 149.1 | | |
| Avg. | 151.1 | 8B1 | 146.4 |
| | | 8B2 | 149.0 |
| 4B1 | 148.2 | 8B3 | 150.7 |
| 4B2 | 141.1 | Avg. | 148.7 |
| 4B3 | 150.6 | | |
| Avg. | 146.6 | Avg. Sect. 8 - | 149.4 |
| Avg. Sect. 4 - | 148.9 | Avg. Bot. Base Course | 147.7 |

SUMMARY CORE DENSITIES FOR RECONSTRUCTED
US 60 AT OLIVE HILL, KENTUCKY, PROJECT FFG 13(8)

| Core No. | Density (lbs/cu. ft.) | | |
|----------|--------------------------|-----------------|----------------------------|
| | | Top Base Course | |
| | | | 501 137.8 |
| | | | 502 146.3 |
| 101 | 149.5 | | 503 145.1 |
| 102 | 149.2 | | Avg. 143.1 |
| 103 | 150.5 | | |
| Avg. | 149.7 | | 5I1 149.3 |
| | | | 5I2 149.8 |
| 1I1 | 143.7 | | 5I3 148.3 |
| 1I2 | 144.6 | | Avg. 149.1 |
| 1I3 | 145.6 | | |
| Avg. | 144.6 | | 5B1 147.5 |
| | | | 5B2 148.5 |
| 1B1 | 144.3 | | 5B3 147.9 |
| 1B2 | 143.3 | | Avg. 148.0 |
| 1B3 | 143.5 | | |
| Avg. | 143.7 | | Avg. Sect. 5 - 146.7 |
| | | Avg. Sect. 1 - | |
| | 146.0 | | 801 144.2 |
| | | | 802 144.9 |
| 401 | 144.8 | | 803 150.6 |
| 402 | 150.5 | | Avg. 146.6 |
| 403 | 149.8 | | |
| Avg. | 148.4 | | 8I1 151.7 |
| | | | 8I2 152.1 |
| 4I1 | 148.3 | | 8I3 152.3 |
| 4I2 | 154.1 | | Avg. 152.1 |
| 4I3 | 148.3 | | |
| Avg. | 150.2 | | 8B1 152.5 |
| | | | 8B2 151.6 |
| 4B1 | 150.0 | | 8B3 149.7 |
| 4B2 | 149.0 | | Avg. 151.3 |
| 4B3 | 150.0 | | |
| Avg. | 149.7 | | Avg. Sect. 8 - 150.0 |
| | | Avg. Sect. 4 - | |
| | 149.4 | | Avg. Top Base Course 148.0 |

SUMMARY CORE DENSITIES FOR RECONSTRUCTED
US 60 AT OLIVE HILL, KENTUCKY, PROJECT FFG 13(8)

| Core No. | Density (lbs/cu. ft.) | Core No. | Density (lb/cu. ft.) |
|----------------|-----------------------|----------------------|----------------------|
| Binder Course | | | |
| 1Q1 | 151.6 | 5Q1 | 147.1 |
| 1Q2 | 153.3 | 5Q2 | 149.0 |
| 1Q3 | 147.4 | 5Q3 | 147.1 |
| Avg. | 150.8 | Avg. | 147.7 |
| 1I1 | 140.5 | 5I1 | 145.0 |
| 1I2 | 145.0 | 5I2 | 143.6 |
| 1I3 | 141.4 | 5I3 | 150.4 |
| Avg. | 142.3 | Avg. | 146.3 |
| 1B1 | 147.8 | 5B1 | 150.0 |
| 1B2 | 148.5 | 5B2 | 149.1 |
| 1B3 | 141.4 | 5B3 | 150.4 |
| Avg. | 145.9 | Avg. | 149.8 |
| Avg. Sect. 1 - | 146.3 | Avg. Sect. 5 - | 147.9 |
| 4Q1 | 149.1 | 8Q1 | 145.3 |
| 4Q2 | 153.8 | 8Q2 | 149.6 |
| 4Q3 | 148.8 | 8Q3 | 150.7 |
| Avg. | 149.1 | Avg. | 148.5 |
| 4I1 | 150.8 | 8I1 | 151.9 |
| 4I2 | 151.7 | 8I2 | 151.3 |
| 4I3 | 152.0 | 8I3 | 149.5 |
| Avg. | 151.5 | Avg. | 150.9 |
| 4B1 | 146.1 | 8B1 | 155.4 |
| 4B2 | 144.4 | 8B2 | 153.7 |
| 4B3 | 148.4 | 8B3 | 149.8 |
| Avg. | 146.3 | Avg. | 153.0 |
| Avg. Sect. 4 - | 149.5 | Avg. Sect. 8 - | 150.8 |
| | | Avg. Binder Course - | 148.6 |

SUMMARY CORE DENSITIES FOR RECONSTRUCTED
US 60 AT OLIVE HILL, KENTUCKY PROJECT, FFG 13(8)

| Core No. | Density (lbs/cu. ft.) | Core No. | Density (lbs/cu. ft.) |
|-----------------|-----------------------|-----------------------|-----------------------|
| Surface Course* | | | |
| 1Q1 | 141.6 | 5Q1 | 142.0 |
| 1Q2 | 143.6 | 5Q2 | 142.0 |
| 1Q3 | 142.5 | 5Q3 | 142.0 |
| Avg. | 142.6 | Avg. | 142.0 |
| 1I1 | 141.6 | 5I1 | 140.6 |
| 1I2 | 140.8 | 5I2 | 142.6 |
| 1I3 | 141.2 | 5I3 | 143.0 |
| Avg. | 141.2 | Avg. | 142.1 |
| 1B1 | 140.6 | 5B1 | 142.9 |
| 1B2 | 140.7 | 5B2 | 143.2 |
| 1B3 | 139.8 | 5B3 | 143.4 |
| Avg. | 140.3 | Avg. | 143.2 |
| Avg. Sect. 1 - | 141.4 | Avg. Sect. 5 - | 142.2 |
| 4Q1 | 151.9 | 8Q1 | 140.9 |
| 4Q2 | 142.0 | 8Q2 | 149.2 |
| 4Q3 | 141.2 | 8Q3 | 142.3 |
| Avg. | 145.0 | Avg. | 144.1 |
| 4I1 | 140.6 | 8I1 | 139.7 |
| 4I2 | 141.2 | 8I2 | 140.2 |
| 4I3 | 141.2 | 8I3 | 140.3 |
| Avg. | 141.0 | Avg. | 140.1 |
| 4B1 | 141.3 | 8B1 | 142.0 |
| 4B2 | 141.6 | 8B2 | 141.6 |
| 4B3 | 141.2 | 8B3 | 139.6 |
| Avg. | 141.4 | Avg. | 141.1 |
| Avg. Sect. 4 - | 142.5 | Avg. Sect. 8 - | 141.8 |
| | | Avg. Surface Course - | 142.0 |

Density of the surface course was determined by weighing specimens in air and in water. Densities of the other courses were determined by weighing the specimens in air and finding the volumes from dimensions.

ALTERNATE AGGREGATES
FOR BITUMINOUS MIXES

L.S. = Limestone
Sl. = Slag
G. = Gravel

| No. | County | No. | County | No. | County |
|-----|--------------------|-----|----------------------|-----|-------------------|
| 1 | ADAIR L.S. | 41 | GRANT L.S.-G. | 81 | MASON L.S.-G. |
| 2 | ALLEN L.S. | 42 | GRAVES L.S.-G. | 82 | MEADE L.S. G. |
| 3 | ANDERSON L.S. | 43 | GRAYSON L.S. | 83 | MENIFEE L.S. |
| | | 44 | GREEN L.S. | 84 | MERCER L.S. |
| 4 | BALLARD L.S.-G. | 45 | GREENUP L.S.-SL.-G. | 85 | METCALFE L.S. |
| 5 | BARREN L.S. | | | 86 | MONROE L.S. |
| 6 | BATH L.S. | 46 | HANCOCK L.S. | 87 | MONTGOMERY L.S. |
| 7 | BELL L.S. | 47 | HARDIN L.S. | 88 | MORGAN L.S. |
| 8 | BOONE L.S.-G. | 48 | HARLAN L.S. | 89 | MUHLENBERG L.S. |
| 9 | BOURBON L.S. | 49 | HARRISON L.S. G. | | |
| 10 | BOYD L.S.-SL.-G. | 50 | HART L.S. | 90 | NELSON L.S. |
| 11 | BOYLE L.S. | 51 | HENDERSON L.S.-G. | 91 | NICHOLAS L.S. G. |
| 12 | BRACKEN L.S.-G. | 52 | HENRY L.S.-G. | | |
| 13 | BREATHITT L.S. | 53 | HICKMAN L.S.-G. | 92 | OHIO L.S. |
| 14 | BRECKINRIDGE L.S. | 54 | HOPKINS L.S. | 93 | OLDHAM L.S.-G. |
| 15 | BULLITT L.S.-G. | | | 94 | OWEN L.S.-G. |
| 16 | BUTLER L.S. | 55 | JACKSON L.S. | 95 | OWSLEY L.S. |
| | | 56 | JEFFERSON L.S.-G. | | |
| 17 | CALDWELL L.S. | 57 | JESSAMINE L.S. | 96 | PENDLETON L.S. G. |
| 18 | CALLOWAY L.S. | 58 | JOHNSON L.S.-SL. | 97 | PERRY L.S. |
| 19 | CAMPBELL L.S.-G. | | | 98 | PIKE L.S.-SL.-G. |
| 20 | CARLISLE L.S.-G. | 59 | KENTON L.S.-G. | 99 | POWELL L.S. |
| 21 | CARROLL L.S.-G. | 60 | KNOTT L.S.-SL. | 100 | PULASKI L.S. |
| 22 | CARTER L.S.-SL.-G. | 61 | KNOX L.S. | | |
| 23 | CASEY L.S. | | | 101 | ROBERTSON L.S. G. |
| 24 | CHRISTIAN L.S. | 62 | LARUE L.S. | 102 | ROCKCASTLE L.S. |
| 25 | CLARK L.S. | 63 | LAUREL L.S. | 103 | ROWAN L.S. |
| 26 | CLAY L.S. | 64 | LAWRENCE L.S.-SL.-G. | 104 | RUSSELL L.S. |
| 27 | CLINTON L.S. | 65 | LEE L.S. | | |
| 28 | CRITTENDEN L.S. | 66 | LESLIE L.S. | 105 | SCOTT L.S. |
| 29 | CUMBERLAND L.S. | 67 | LETCHER L.S. | 106 | SHELBY L.S. |
| | | 68 | LEWIS L.S.-SL.-G. | 107 | SIMPSON L.S. |
| 30 | DAVIESS L.S. | 69 | LINCOLN L.S. | 108 | SPENCER L.S. |
| | | 70 | LIVINGSTON L.S. | | |
| 31 | EDMONSON L.S. | 71 | LOGAN L.S. | 109 | TAYLOR L.S. |
| 32 | ELLIOTT L.S. | 72 | LYON L.S. | 110 | TODD L.S. |
| 33 | ESTILL L.S. | | | 111 | TRIGG L.S. |
| | | 73 | McCRACKEN L.S.-G. | 112 | TRIMBLE L.S.-G. |
| 34 | FAYETTE L.S. | 74 | McCREARY L.S. | | |
| 35 | FLEMING L.S. G. | 75 | McCLEAN L.S. | 113 | UNION L.S. |
| 36 | FLOYD L.S.-SL. | | | | |
| 37 | FRANKLIN L.S. | 76 | MADISON L.S. | 114 | WARREN L.S. |
| 38 | FULTON L.S.-G. | 77 | MAGOFFIN L.S.-SL. | 115 | WASHINGTON L.S. |
| | | 78 | MARION L.S. | 116 | WAYNE L.S. |
| 39 | GALLATIN L.S.-G. | 79 | MARSHALL L.S. | 117 | WEBSTER L.S. |
| 40 | GARRARD L.S. | 80 | MARTIN L.S.-SL.-G. | 118 | WHITLEY L.S. |
| | | | | 119 | WOLFE L.S. |
| | | | | 120 | WOODFORD L.S. |