

2016 Annual Airport Conference



Federal Aviation
Administration

Random Sampling Techniques

Presented to: Airport Asphalt Pavement Workshop
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Date: March 22, 2016



Random Sampling technique

Section 6 of ERLPM



Random sampling rules

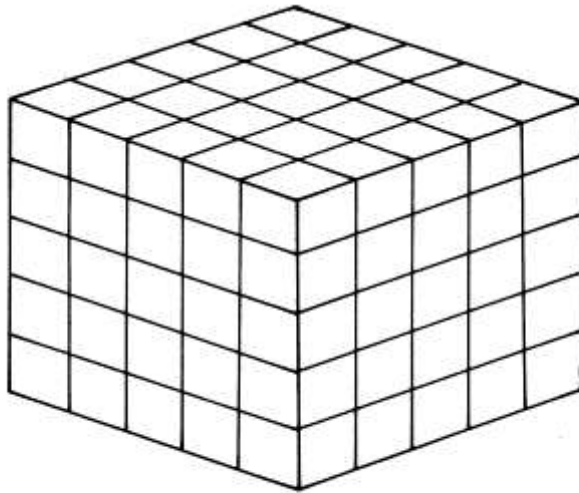
- **Philosophy for random sampling**
- **Material selection**
- **Size of production**
- **Partial production**
- **Sampling methods for plant produced material**
- **Sampling practice for field placed material**
- **Sampling joints**



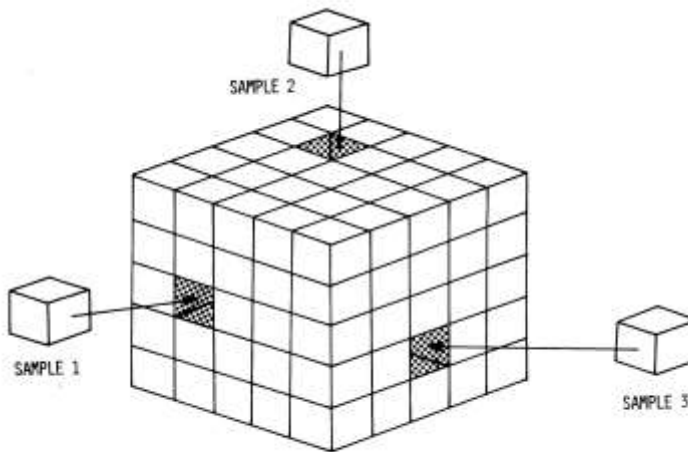
Considerations for Random sampling

- Same Materials
- Same Process
- Same Opportunity to be Selected





LOT



Example of Samples Selected from a Lot



Two processes for selecting as testing materials

- Testing material as produced by the plant:
there are two methods:
 - a) Selecting by time
 - b) Selecting by weight
- Testing material compacted in the field



Size/quantity of material to be tested

- *Plant produced material:*
 - a) *One Day's production ≤ 2000 Tons*
 - b) *Half Day's production when Day Production is $2000 < \text{Day} > 4000$ Tons*
- *Field Compacted material: the size generated by the plant produced material*



Sampling the lot

- *Divide Lot into 4 Equal sublots except for Test Strip were the lot is divided by 3*
- *Take sample from each subplot*



What happen is production has to stop? – Partial lots

- *3-4 samples were taken, sublots Constitute a Lot*
- *1-2 sublots add to next day*
- *Next day production would have 3-6 sublots*



Sampling plant produced material

- *Sample by Time*
- *Sample by weight (Tonnage)*



Sampling by time - example

- *Production Duration 10 HRS*
- *Sublots: $10/4 = 2 \frac{1}{2}$ Hrs = 150 minutes*
- *Assuming trucks will leave every 10 Min.*
- *Increment $150 / 10 = 15$ trucks*
- *Form 15 numbered pieces and put them in a bowl*
- *Draw one per Sublot*
- *Sample the truck at time selected*



Sampling by weight - Example

- *Lot size 2000 Tons*
- *Assuming load on Trucks = 20 Tons*
- *Sublots size $2000/4 = 500$ Tons*
- *Increment $500/20 = 25$ trucks per subplot*
- *Form 25 numbered pieces and put them in a bowl*
- *Select one for each subplot*
- *Sample the selected truck*



Sampling field compacted material

- *Lot size equal to Plant Produced Material, however the Plant Produced Material may have 3-6 sublots*
- *Divide the lot into 4 sublots (regardless of the Plant Produced Material sublots)*
- *Use Random Sampling Table 1 on Pages 40/41 of ERLLM*
- *Form 28 Numbered Pieces*
- *Randomly select a number per lot*



Using random tables

- *Column A is the Sublot number*
- *Column B is the longitudinal factor used to identify location along the length of sublot*
- *Column C is the lateral factor used to identify location from referenced side of sublot*
- *If the same number is drawn, use the following set of 4*



Col. No. 1			Col. No. 2			Col. No. 3			Col. No. 4			Col. No. 5			Col. No. 6			Col. No. 7		
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
15	.033	.576	05	.048	.879	21	.013	.220	16	.089	.716	17	.024	.363	30	.030	.901	12	.029	.384
21	.101	.300	17	.074	.156	30	.036	.853	10	.102	.330	24	.060	.032	21	.096	.190	18	.112	.284
23	.129	.916	18	.102	.191	10	.059	.746	14	.111	.925	26	.074	.639	10	.100	.161	20	.114	.848
30	.158	.434	06	.105	.357	25	.061	.954	28	.127	.840	07	.167	.512	29	.133	.388	03	.121	.456
24	.177	.397	38	.179	.447	29	.062	.507	24	.132	.271	28	.194	.776	24	.138	.062	13	.178	.640
11	.202	.571	26	.187	.844	18	.087	.887	19	.285	.899	03	.219	.166	20	.168	.564	22	.209	.421
16	.204	.012	04	.188	.482	24	.105	.849	01	.326	.037	39	.264	.264	22	.232	.933	16	.221	.311
08	.208	.418	02	.208	.377	07	.139	.139	30	.334	.928	11	.282	.262	14	.339	.217	29	.233	.356
19	.211	.798	03	.214	.402	01	.129	.641	22	.403	.295	14	.379	.994	01	.375	.195	28	.364	.941
29	.233	.070	07	.248	.080	23	.196	.873	05	.421	.282	13	.394	.403	06	.277	.475	11	.387	.199
07	.260	.073	15	.248	.831	26	.240	.981	13	.451	.212	06	.410	.157	02	.396	.497	02	.336	.992
17	.262	.308	29	.261	.087	14	.255	.374	02	.461	.023	13	.438	.700	26	.311	.144	13	.393	.488
25	.271	.180	30	.302	.883	06	.310	.043	06	.487	.339	22	.433	.635	05	.351	.141	19	.437	.655
06	.202	.672	21	.318	.088	11	.316	.653	08	.497	.396	21	.472	.824	17	.370	.811	24	.466	.772
01	.409	.606	11	.376	.936	13	.324	.585	25	.503	.893	03	.488	.110	09	.388	.484	14	.531	.014
13	.507	.693	14	.430	.814	12	.351	.373	15	.394	.603	01	.325	.222	04	.410	.073	09	.562	.678
02	.375	.654	27	.438	.676	20	.371	.535	27	.420	.894	12	.561	.780	25	.471	.530	06	.601	.573
18	.591	.318	08	.467	.203	08	.409	.495	21	.629	.841	08	.632	.508	13	.486	.779	10	.612	.839
20	.610	.821	09	.474	.138	16	.445	.740	17	.691	.383	18	.668	.271	15	.515	.867	26	.673	.112
12	.631	.397	10	.492	.674	03	.494	.929	09	.708	.689	30	.736	.634	23	.567	.798	23	.738	.770
27	.651	.381	13	.499	.892	27	.543	.387	07	.709	.012	02	.763	.252	11	.618	.502	21	.733	.614
04	.661	.933	19	.511	.520	17	.633	.171	11	.714	.049	23	.804	.140	28	.636	.148	30	.738	.851
22	.692	.089	23	.591	.770	02	.699	.073	23	.720	.695	23	.828	.425	27	.650	.741	27	.765	.363
05	.779	.346	20	.604	.730	19	.702	.934	03	.748	.413	10	.843	.627	16	.711	.508	07	.780	.534
09	.787	.173	24	.654	.330	22	.816	.802	20	.781	.602	16	.898	.849	19	.778	.812	04	.818	.187
10	.818	.837	12	.728	.533	04	.838	.166	26	.830	.384	06	.903	.327	07	.804	.675	17	.837	.353
14	.895	.631	16	.753	.344	15	.904	.116	04	.843	.002	09	.912	.382	08	.806	.952	05	.854	.818
26	.912	.376	01	.806	.134	28	.949	.742	12	.884	.982	27	.933	.162	18	.841	.414	01	.867	.133
28	.920	.163	22	.878	.884	09	.974	.046	29	.926	.700	20	.970	.582	12	.918	.114	08	.915	.538
03	.945	.140	25	.939	.162	05	.977	.494	16	.931	.601	19	.973	.327	03	.992	.399	25	.975	.384



Example of determination of cores locations

- From bowl with 28 numbered pieces, number 12 is Drawn
- From Column "A" Select Lines 01, 02, 03 and 04
- From column B: .320, .489, .542, .153
- From Column C: .212, .827, .352, .163



Col. No. 8	Col. No. 9			Col. No. 10			Col. No. 11			Col. No. 12			Col. No. 13			Col. No. 14				
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C		
09	.042	.071	14	.061	.935	26	.038	.023	27	.074	.779	16	.073	.987	03	.033	.091	26	.035	.175
17	.141	.411	02	.065	.097	30	.066	.371	06	.094	.396	23	.078	.036	07	.047	.391	17	.089	.363
02	.143	.321	03	.094	.228	27	.073	.876	24	.098	.524	17	.096	.076	28	.064	.113	10	.149	.681
05	.162	.899	16	.122	.945	09	.095	.568	10	.133	.919	04	.153	.163	12	.066	.360	28	.238	.075
03	.285	.016	18	.158	.430	05	.180	.741	15	.187	.079	10	.254	.834	26	.076	.552	13	.244	.747
28	.291	.034	25	.193	.449	12	.200	.851	17	.227	.747	06	.284	.628	30	.087	.101	24	.262	.366
08	.349	.557	24	.224	.372	13	.259	.327	20	.236	.571	12	.305	.614	02	.127	.187	08	.264	.651
01	.436	.386	10	.225	.223	21	.264	.681	01	.245	.988	25	.319	.901	05	.144	.068	18	.285	.311
20	.430	.289	09	.233	.838	17	.283	.645	04	.317	.291	01	.320	.212	25	.202	.674	02	.340	.131
18	.455	.789	20	.290	.120	23	.363	.063	29	.350	.911	08	.416	.372	01	.247	.023	29	.353	.478
23	.488	.715	01	.297	.242	20	.364	.366	26	.380	.104	13	.432	.556	23	.253	.323	06	.359	.270
14	.496	.274	11	.337	.760	16	.395	.363	28	.425	.864	02	.489	.827	24	.320	.651	20	.387	.348
15	.503	.342	19	.389	.064	02	.423	.540	22	.487	.526	29	.503	.787	10	.328	.365	14	.392	.694
04	.515	.693	13	.411	.474	08	.432	.736	05	.532	.511	15	.518	.717	27	.338	.412	03	.408	.077
16	.532	.112	20	.447	.893	10	.476	.468	14	.564	.357	28	.524	.998	13	.356	.991	27	.440	.280
22	.557	.337	22	.478	.321	03	.508	.774	11	.572	.306	03	.542	.352	16	.401	.792	22	.461	.830
11	.559	.620	29	.481	.993	01	.401	.417	21	.594	.197	19	.583	.462	17	.423	.117	16	.527	.503
12	.650	.216	27	.562	.403	22	.687	.917	09	.607	.524	05	.695	.111	21	.481	.838	30	.531	.486
21	.672	.320	04	.546	.179	29	.697	.862	19	.650	.572	07	.733	.838	08	.560	.401	25	.678	.360
13	.709	.273	08	.603	.758	11	.701	.603	18	.664	.101	11	.744	.948	19	.564	.190	21	.725	.014
07	.745	.687	15	.632	.927	07	.728	.498	25	.674	.428	18	.793	.748	05	.571	.054	05	.797	.599
30	.780	.285	06	.707	.107	14	.745	.679	02	.697	.674	27	.802	.967	18	.887	.584	15	.801	.927
19	.843	.097	28	.737	.161	24	.819	.444	03	.767	.928	21	.826	.487	15	.604	.145	12	.836	.294
26	.846	.366	17	.846	.130	15	.840	.823	16	.809	.529	24	.833	.832	11	.641	.798	04	.854	.982
29	.861	.307	07	.874	.491	25	.863	.568	30	.838	.294	26	.853	.142	22	.472	.156	11	.884	.928
25	.906	.874	05	.880	.828	06	.878	.215	13	.845	.470	14	.861	.462	20	.674	.887	19	.886	.832
24	.919	.809	23	.921	.659	18	.930	.601	08	.855	.524	20	.874	.625	14	.732	.581	07	.929	.932
10	.952	.555	26	.960	.365	04	.954	.827	07	.867	.718	30	.929	.036	09	.774	.560	09	.932	.206
06	.961	.504	21	.978	.194	28	.963	.064	12	.881	.722	09	.935	.582	29	.921	.752	01	.970	.692
27	.969	.811	12	.982	.183	19	.988	.020	23	.927	.872	22	.947	.797	04	.959	.099	23	.973	.083



Pavement geometry

- Pavement Width - 12-1/2 Feet
- Select Reference Side (left)
- Divide lot length
- $1600/4 = 400$ Feet
- Samples to be taken no Closer Than 1 Foot from a Joint



Location of cores - subplot

Sublot 1

Length $400 \times .320 = 128'$

Width $12.5 \times .212 = 3'$

Sublot 2

Length $400 \times .489 = 196'$

Width $12.5 \times .827 = 10'$

Sublot 3

Length $400 \times .542 = 217'$

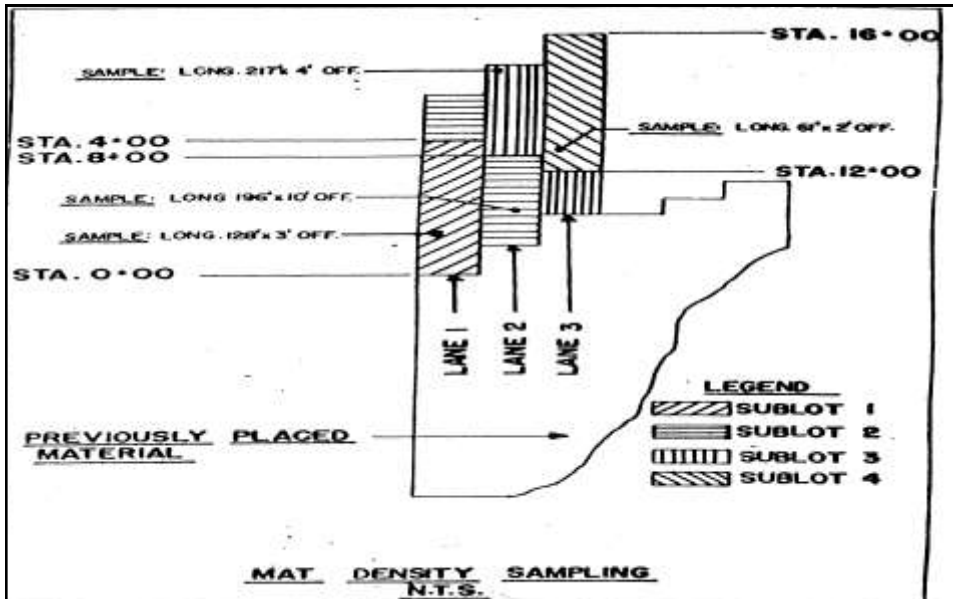
Width $12.5 \times .352 = 4'$

Sublot 4

Length $400 \times .153 = 61'$

Width $12.5 \times .163 = 2'$



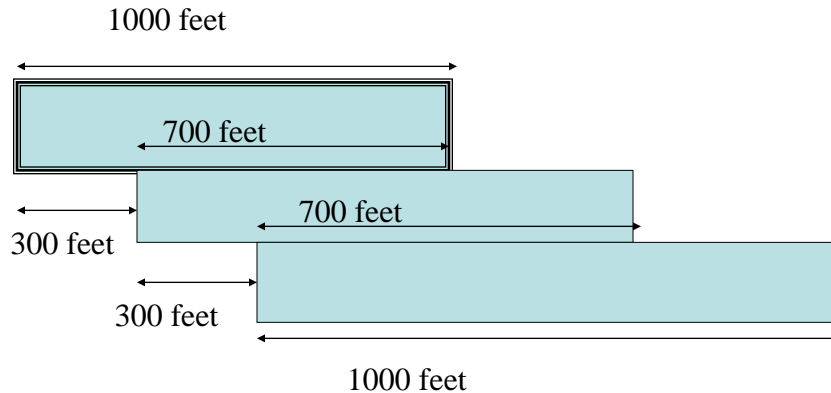


Location of cores for joint testing

- *Could be within same lot or abutting lots*
- *When within two different lots use the lowest specific gravity*
- *Divide length into 4 equal sublots*
- *Directly on the joint (error in P-403)*
- *Minimum diameter 5"*
- *Penalty on joint density*



Joint testing example

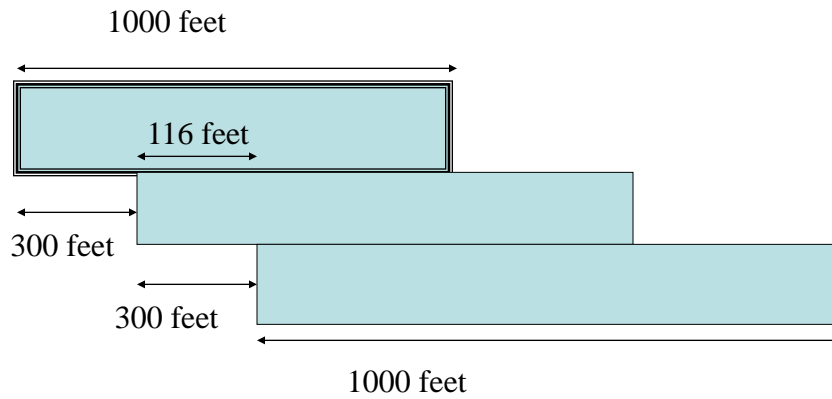


Location of cores for joint testing

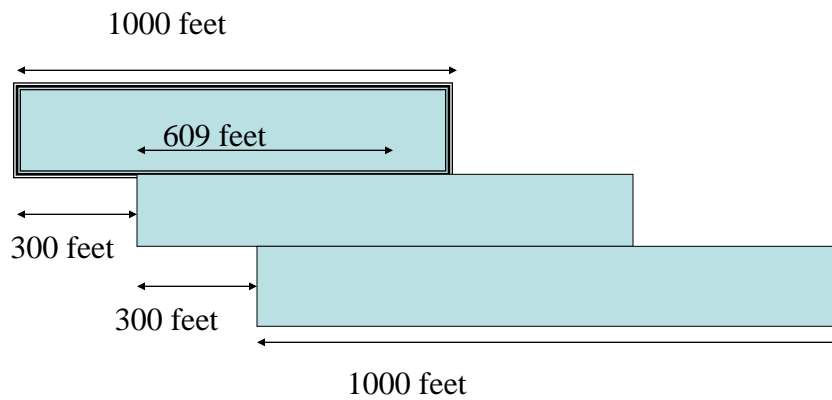
- *From the bowl with 28 numbered pieces we drawn number 16*
- ***B** values for column 16*
- *.331, .739, .548, .516*
- *Sublot 1; $350 \times 0.331 = 115.85 = 116'$*
- *Sublot 2; $350 \times 0.739 + 350 = 608.65 = 609'$*
- *Sublot 3; $350 \times 0.548 = 191.8 = 192'$*
- *Sublot 3; $350 \times 0.516 + 350 = 530.6 = 531'$*



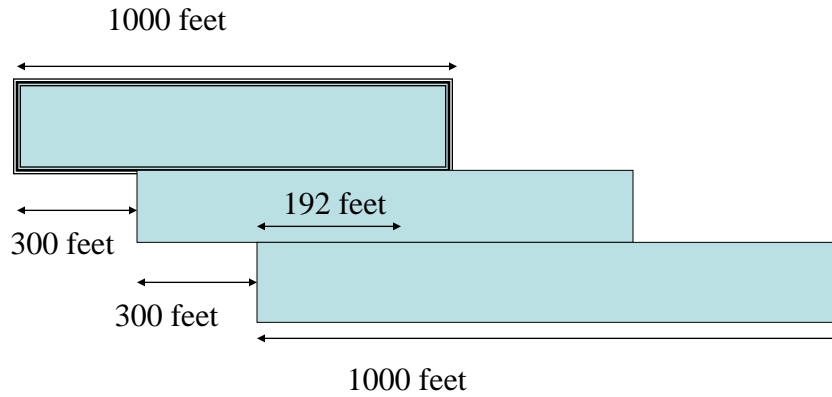
Joint testing



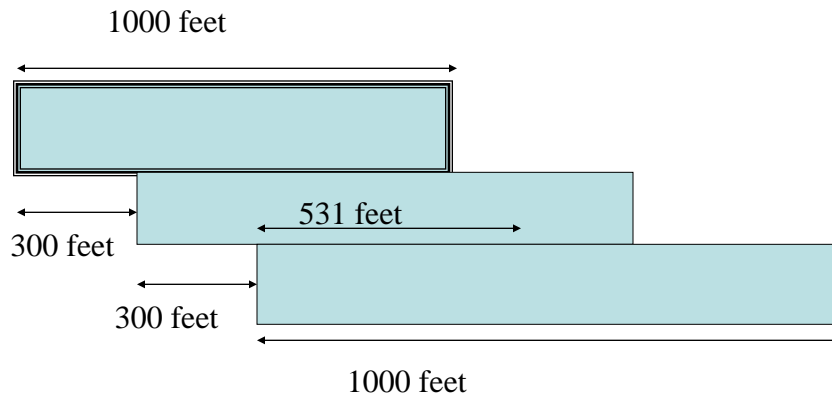
Joint testing



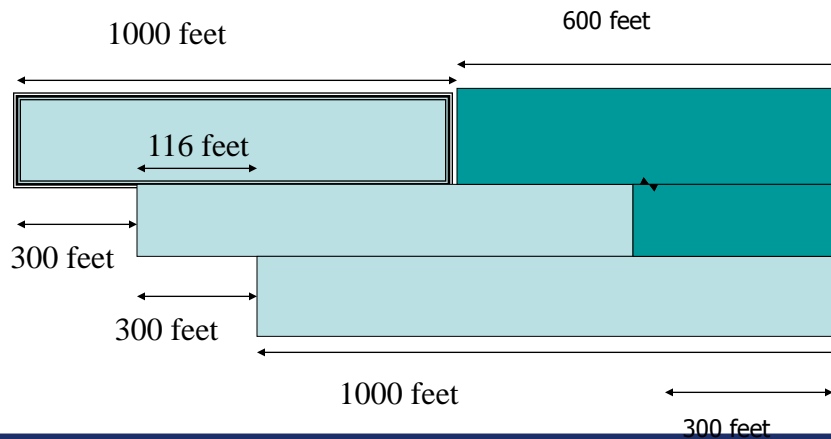
Joint testing



Joint testing



Joint testing – second lane



- Total Joint length
- $600 + 300 = 900$ feet
- $900/4 = 225$ feet
- Number 20 is selected
- Sublot 01 -.415
- Sublot 2 - .958
- Sublot 3 - .150
- Sublot 4 - .154



- Distances along the joint

- Sublot 1 $225 \times .415 = 93.38 = 93$

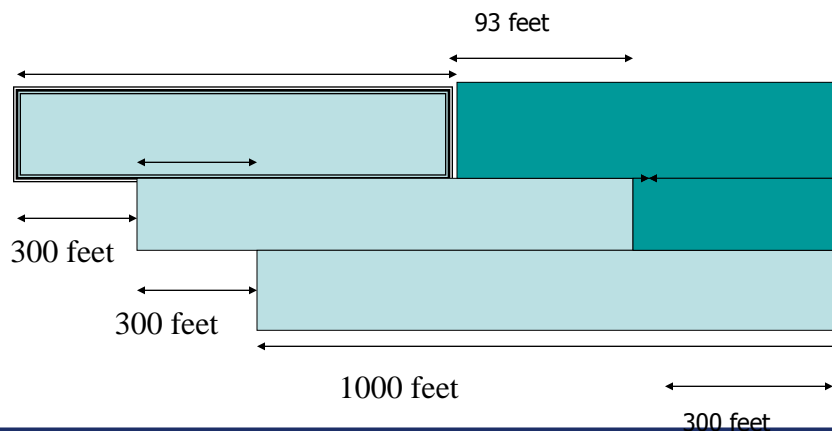
- Sublot 2 $225 \times .958 = 215.55 = 216$

- Sublot 3 $225 \times .150 = 33.75 = 34$

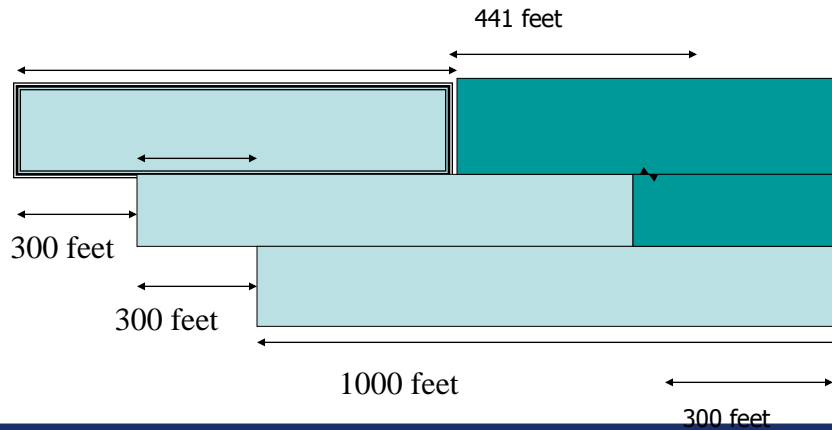
- Sublot 4 $225 \times 34.65 = 35$



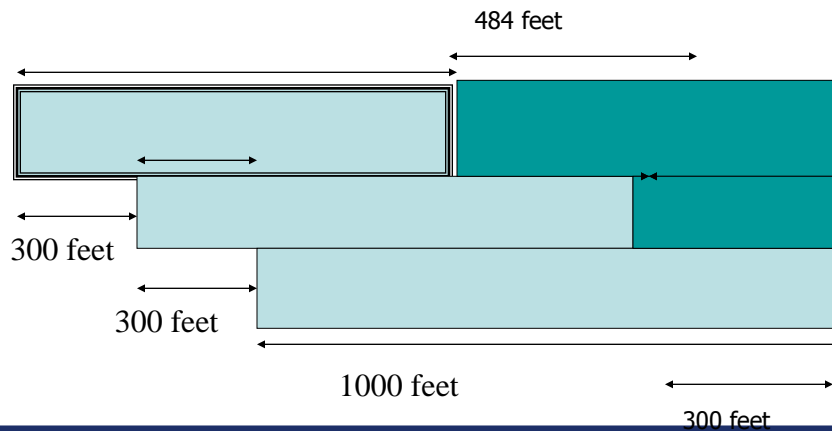
Joint testing – second lane



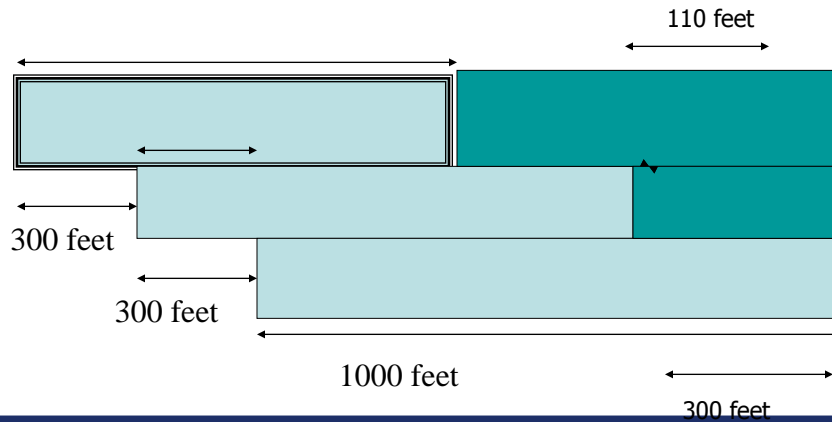
Joint testing – second lane



Joint testing – second lane



Joint testing – second lane



IN-PLACE DENSITY ACCEPTANCE CALCULATION			
LOCATION OF MAT CORES			
SUBLOT NO.	PAVEMENT STATION	OFFSET	
1			
2			
3			
4			
LOCATION OF JOINT CORES			
SUBLOT	PAVEMENT STATION		
1			
2			
3			
4			
CALCULATED BY		DATE	
AFFILIATION			

