



Illinois Asphalt Pavement Association

March 12, 2012 (aka 5-days before St. Patrick's Day)

SURVIVING STATISTICALLY BASED SPECIFICATIONS

Murphy Pavement Technology

Timothy R. Murphy, P.E.

Eight Key Elements for Success

In order to be successful an organization must concentrate on the eight key elements:

Ethics	Integrity
Trust	Training
Teamwork	Leadership
Recognition	Communication

Surviving Statistically Based Specs.

[Click Here to Start](#)

\$100

\$100

\$100

\$100

\$100

\$200

\$200

\$200

\$200

\$200

\$300

\$300

\$300

\$300

\$300

\$400

\$400

\$400

\$400

\$400

\$500

\$500

\$500

\$500

\$500

Final Challenge

Answer: \$300

Rethink, retool, and refine ways we do business; Part One.



Question: \$300

What was asked of industry (IAPA membership) by the Illinois Department of Transportation in the 1990's?



Answer: \$200

Partnering and consensus decision making by IAPA membership, IDOT, and FHWA during QC / QA program development.

Question: \$200

What was needed to obtain program credibility?



Answer: \$300

- Lake Land College; prime.
- Numerous association, contractor, and consultant firms; sub-consultant.



Question: \$300

Who was tasked with training and certifying HMA scientists long term throughout Illinois with continuous IDOT and IAPA guidance?



Answer: \$400

Mean (average), spread (low to high), standard deviation (S: Spread), quality index, and PWL.

$$S = \sqrt{\frac{n * \sum (x)^2 - (\sum x)^2}{n * (n - 1)}}$$



Roman Ondák's room of heights

— Roemer, 29.8.2010

— Astrid, 25.9.2010

— NATHALIE 12.10.2010

— Tessa, 12.10.2010

— Job, 12.10.2010

— Mabledine, 7.9.2010

— Marianne, 10.10.2010

— Ilya, 12.9.2010

— kiran, 25.9.2010

— SUZANNE, 16.9.2010

— Lotte, 17-10-2010

— Jouke, 17-10-2010

— Lora, 19.9.2010

— Alexander, 20.9.2010

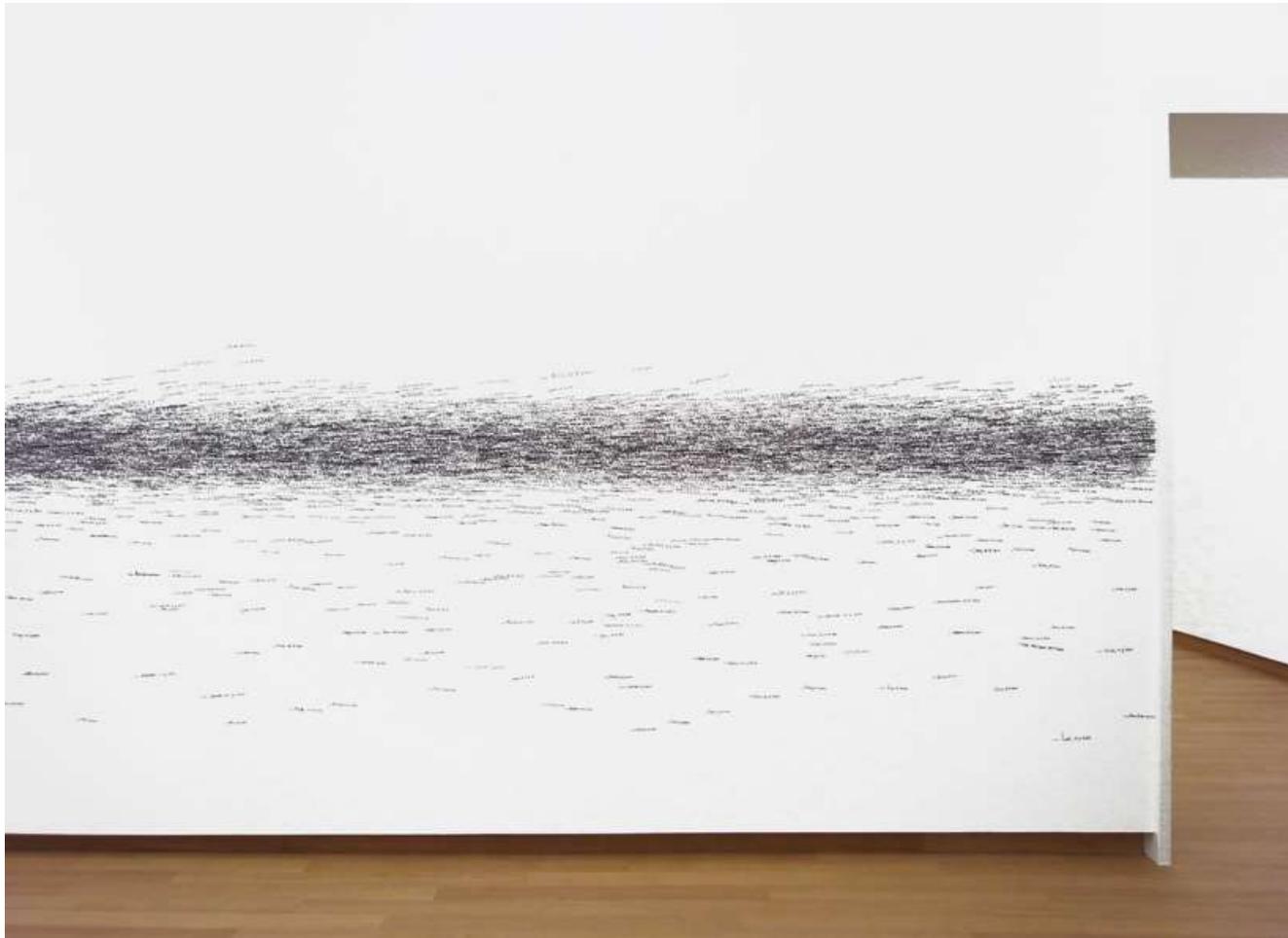
— Stas, 19.9.2010

— Nora, 2.10.2010

— Feia, 25.9.2010

— Laniël, 2.10.2010

Roman Ondák's room of heights



Roman Ondák's room of heights



5' 4.3" and 5' 9.9"

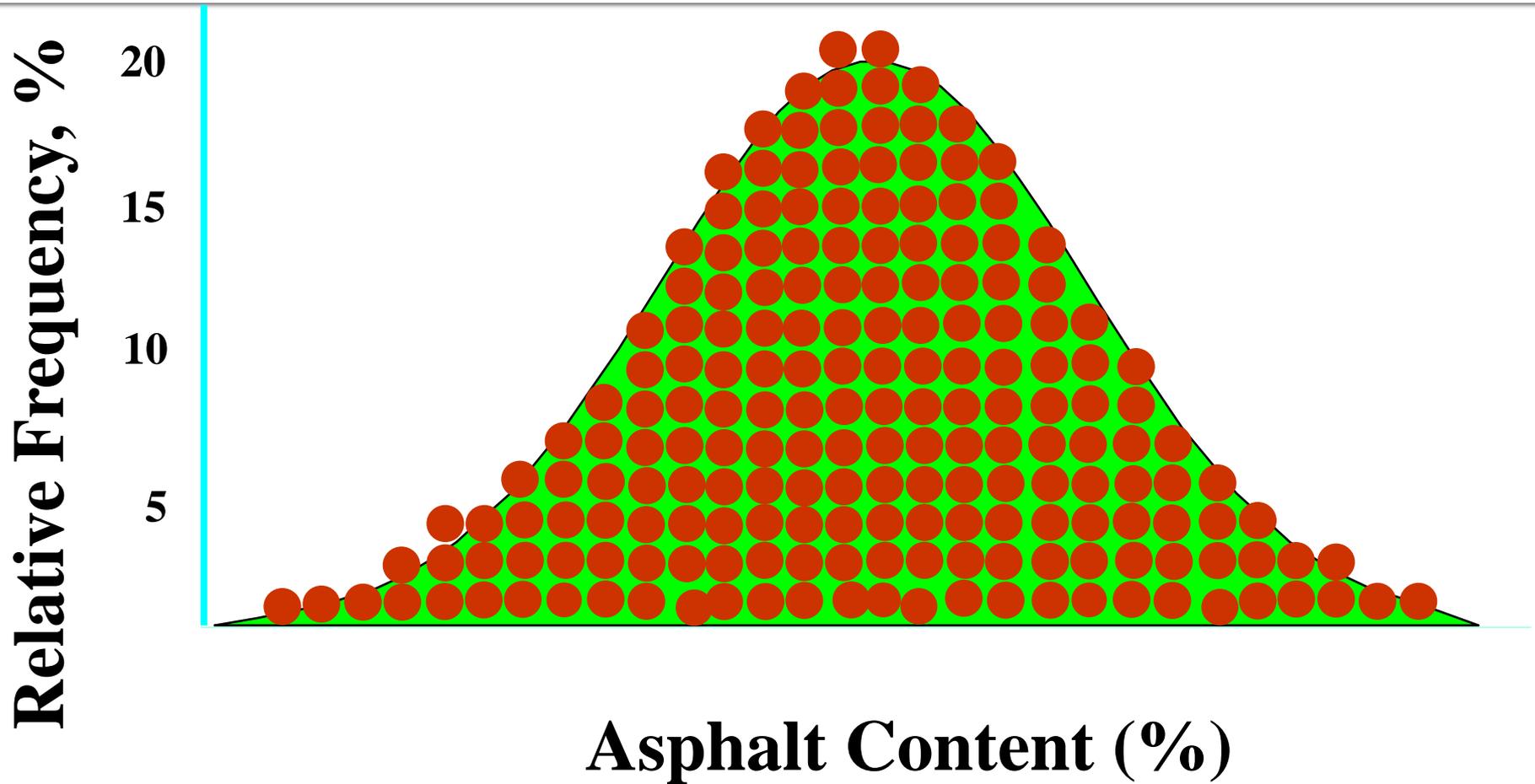


Mean (Average) of 100 AC tests

5.97 6.25 6.19 6.10 6.01
5.88 5.90 5.83 5.93 6.06
6.15 6.13 6.29 6.11 5.94 5.83 5.85 5.91
6.47 6.10 6.02 5.76 6.09 5.96 5.92 6.00
6.23 6.13 6.16 6.07 6.20 5.89 5.81 6.30 5.82 5.88 5.79
5.67 6.03 6.37 6.08 5.45 6.33 6.08 5.96 6.26
5.95 6.14 5.85 6.11 6.17 5.85 5.87 5.77 6.23 5.80 5.92
6.05 6.01 6.04 5.72 5.65 5.78 6.19 5.69 5.97 6.18 5.98
6.02 6.04 5.74 6.24 6.33 5.57 6.00 5.98 6.22 6.06 5.99
5.63 5.86 6.39 6.16 6.12
6.42 5.95 5.94 6.28 6.07 6.03 6.12 5.99 5.93
5.87 5.90 5.62

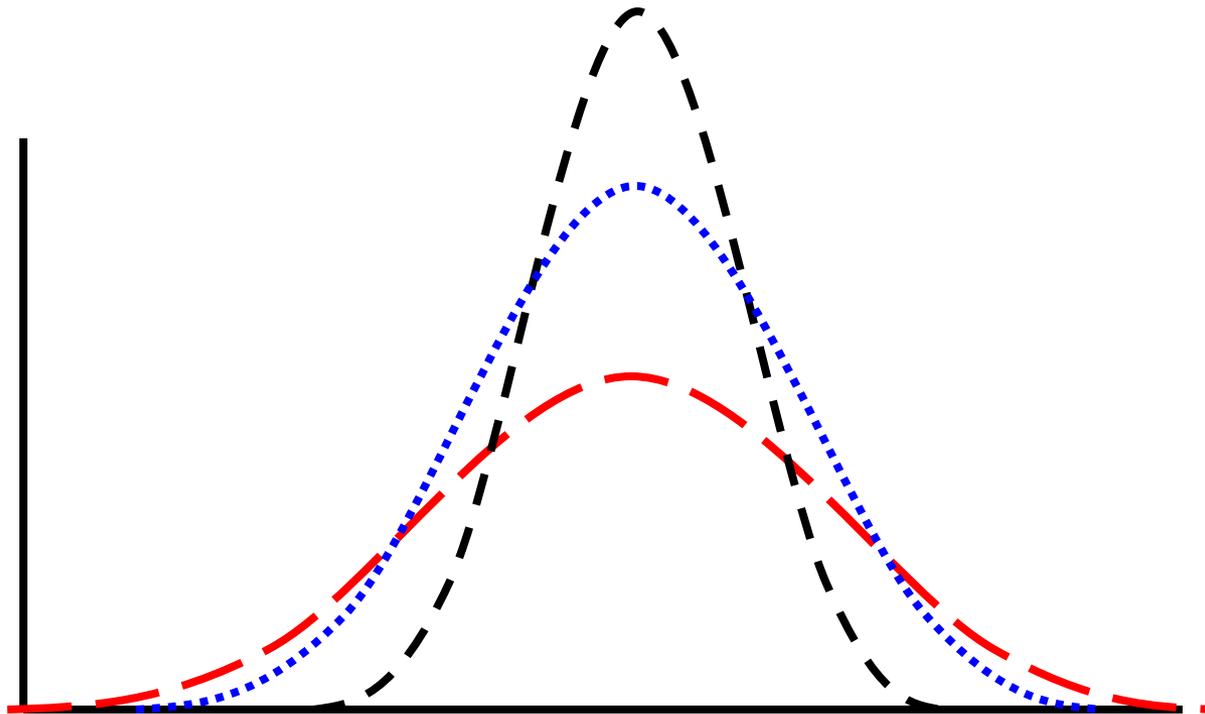
$$\begin{aligned}\text{Mean} &= \text{Sum} / \text{Total Count} \\ &= 599.85 / 100 \\ &= 6.00\end{aligned}$$

Estimate of Population Improves with Increasing Number of Samples



Answer: \$500

The standard deviation (S: Spread) is a statistic that tells you how tightly all the various examples are clustered around the mean in a set of data.



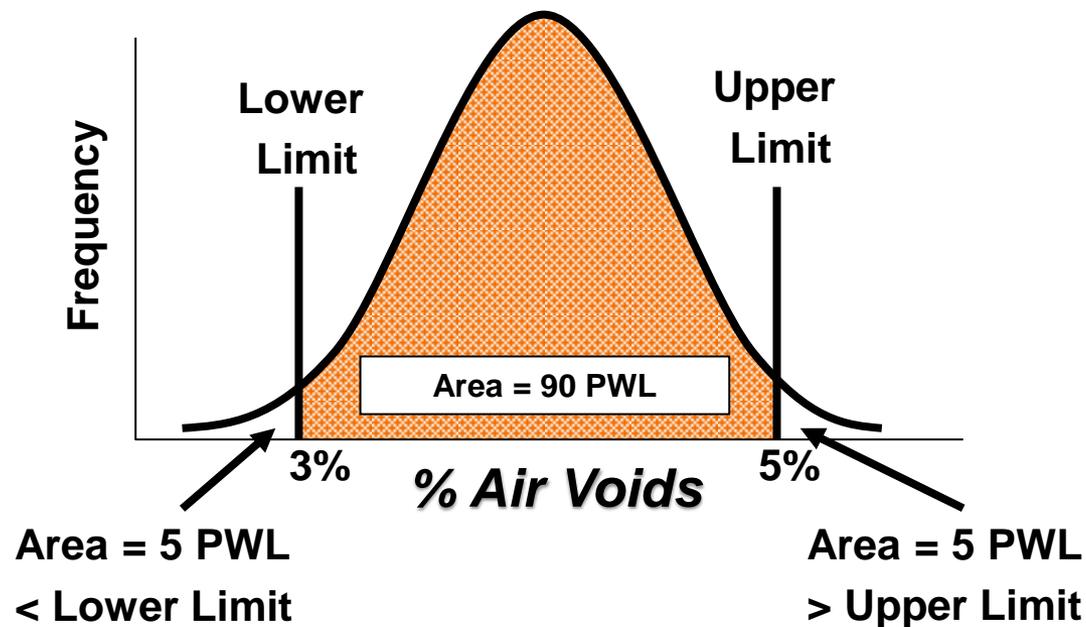
Question: \$500

What is your firm's capability of producing within quality limits consistently?

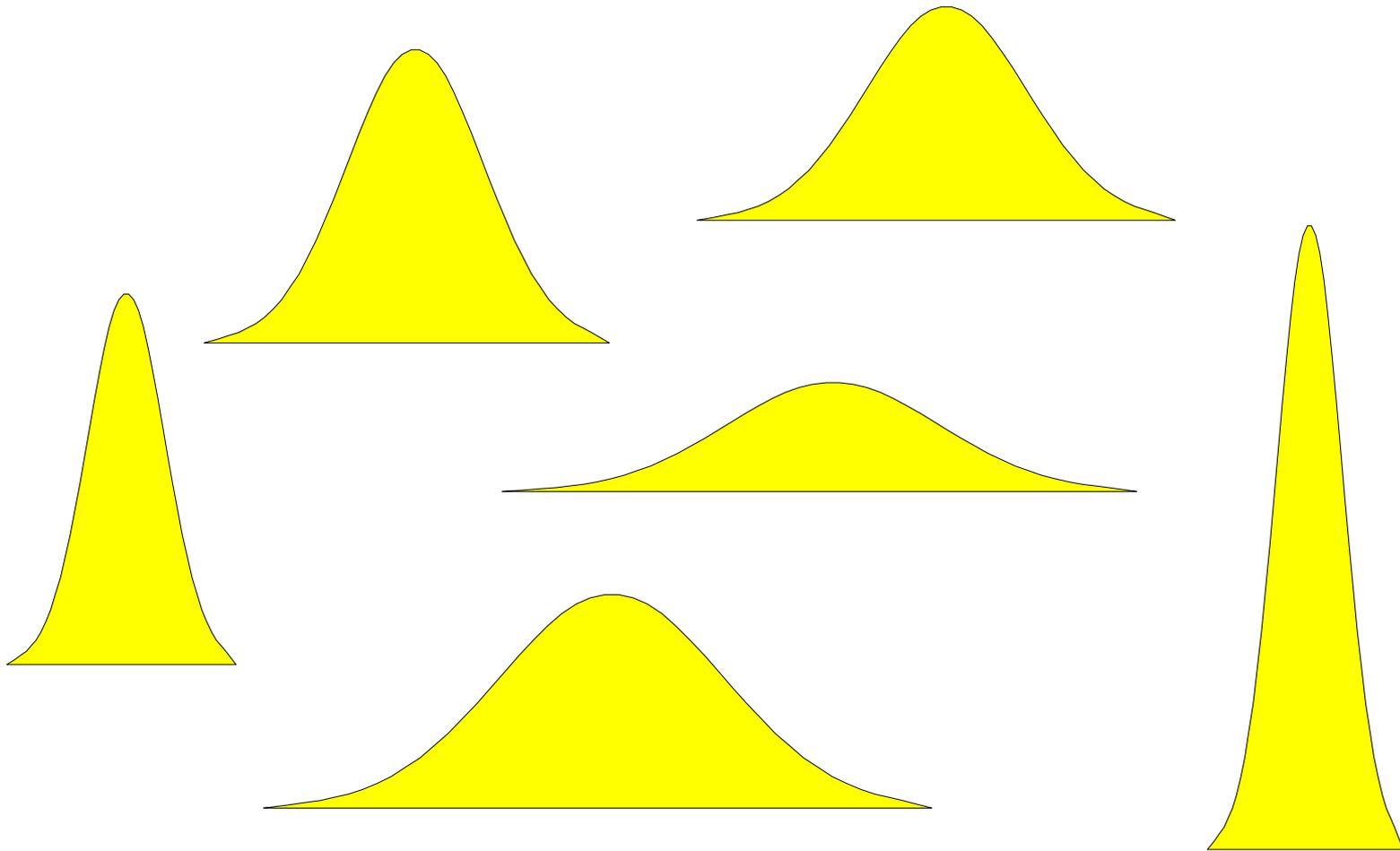
**How well can you
identify, quantify, and solve
production variances?**

What FHWA and IDOT Recognize

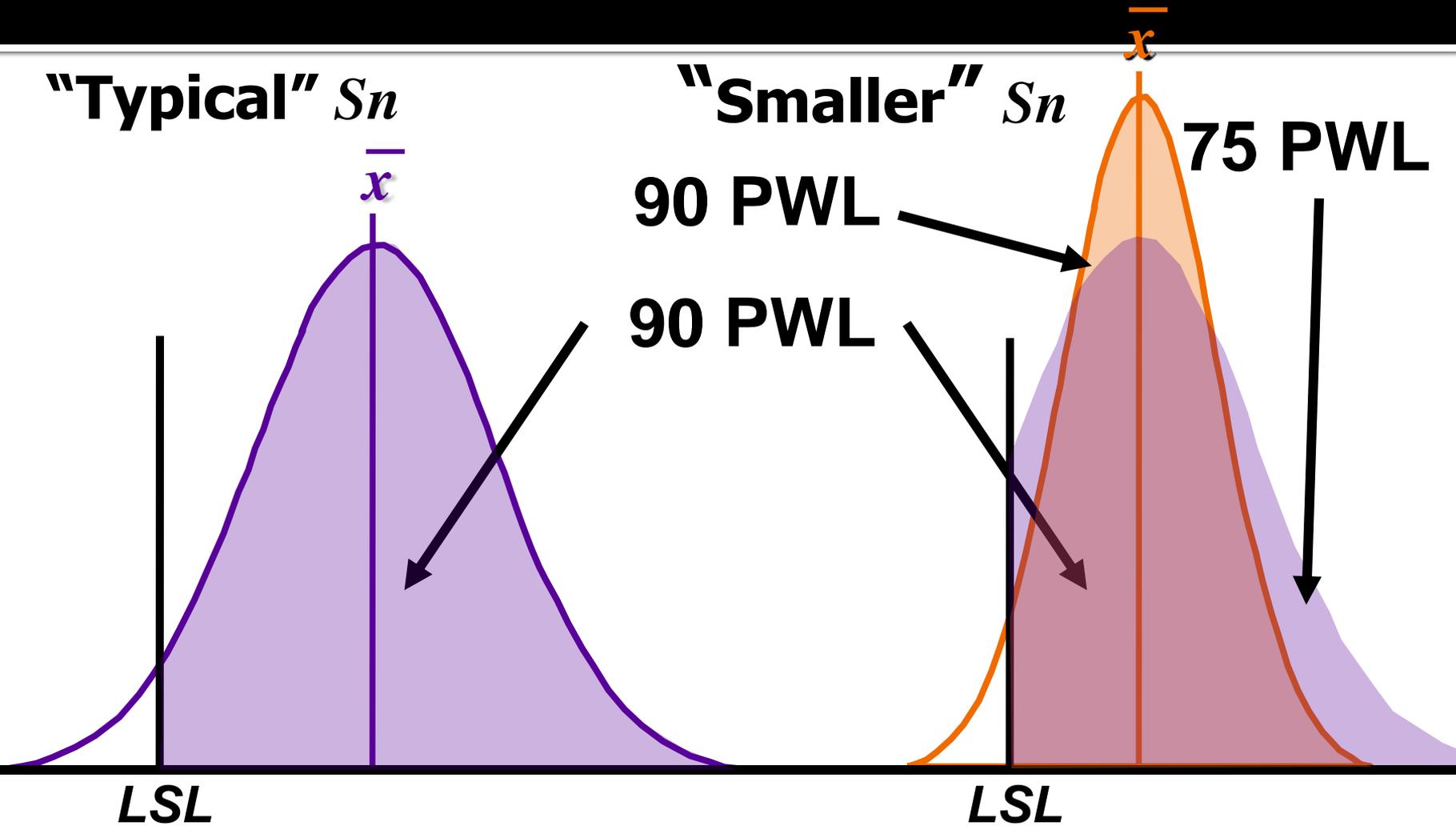
Contractors are capable of and shall receive 100% pay for achieving 90 PWL on an ongoing basis.



Normal Distributions with Different Means and Std. Dev.



QC – Mean & Spread Relationship



Hold a
pre-pave
meeting

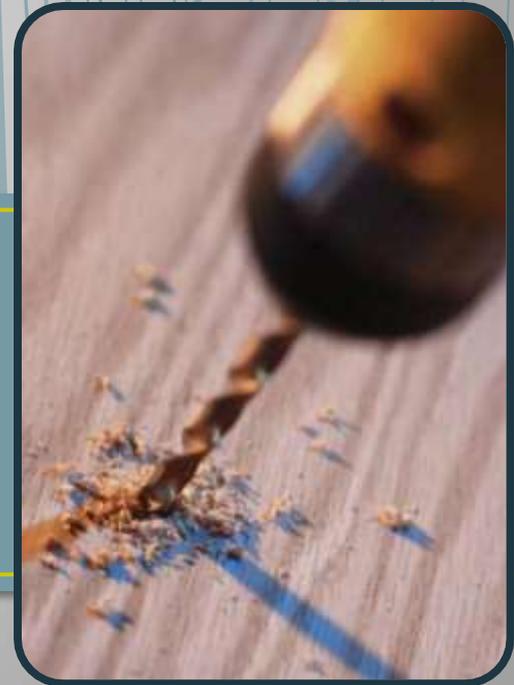


Left (negative) skew



- ① **Materials (Mix Designs & QC)**
- ② **Machinery (Production and Placement Equipment)**
- ③ **Methods (Construction Techniques)**
- ④ **Recommended Action Items**

Drill Down

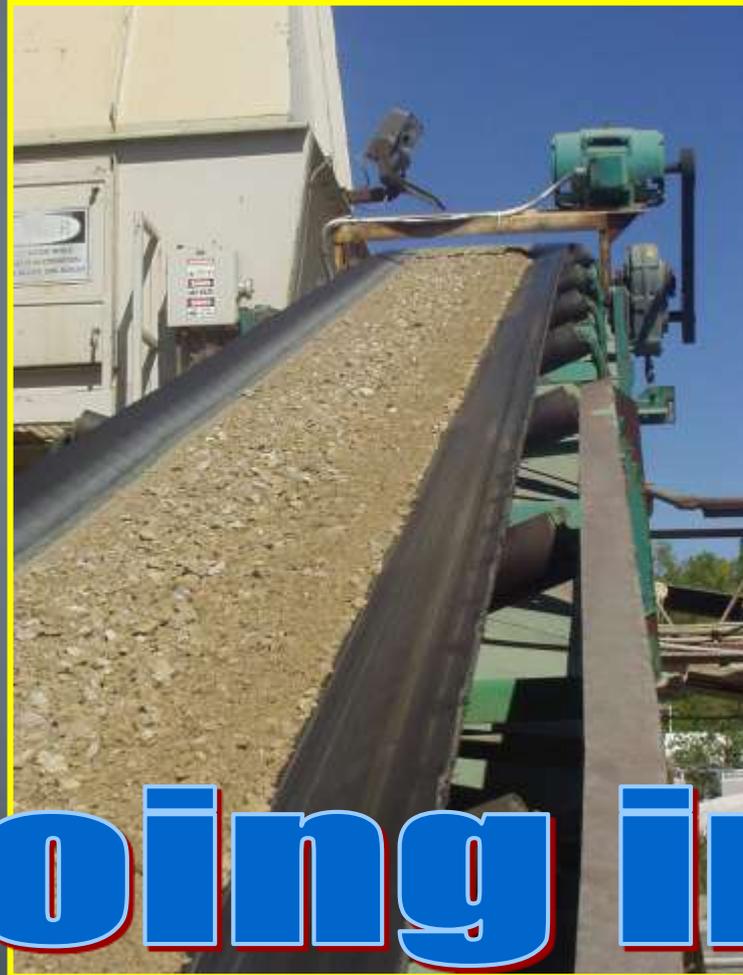


1% moisture = 10% Fuel



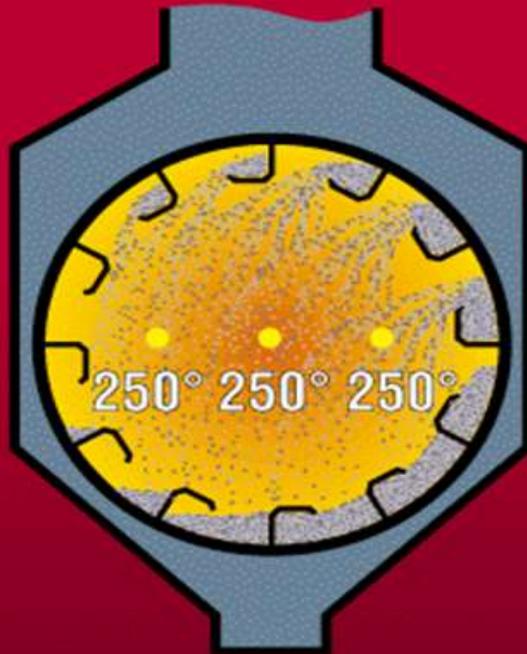
↓ moisture = ↑ Quality

Aggregate Gradation

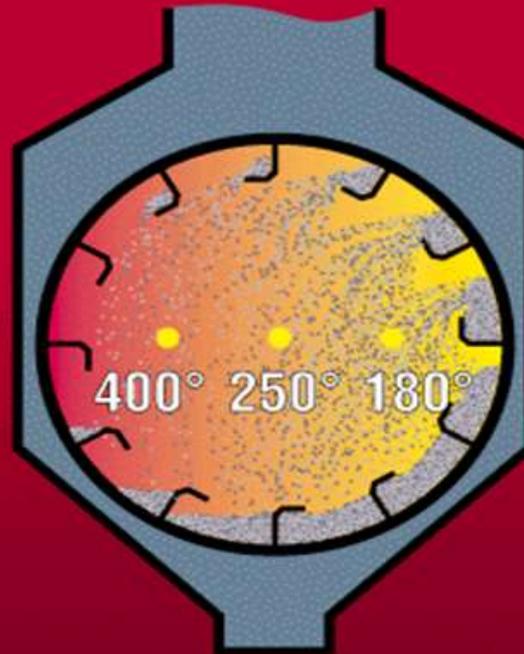


Going in...

How worn flights affect temperatures



NEW FLIGHTS



OLD WORN FLIGHTS

NEW FLIGHTS

OLD WORN FLIGHTS





2010

4

HMA BC N90 19.0R 4740

39

39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

2010

AC

1/10"=0.02%

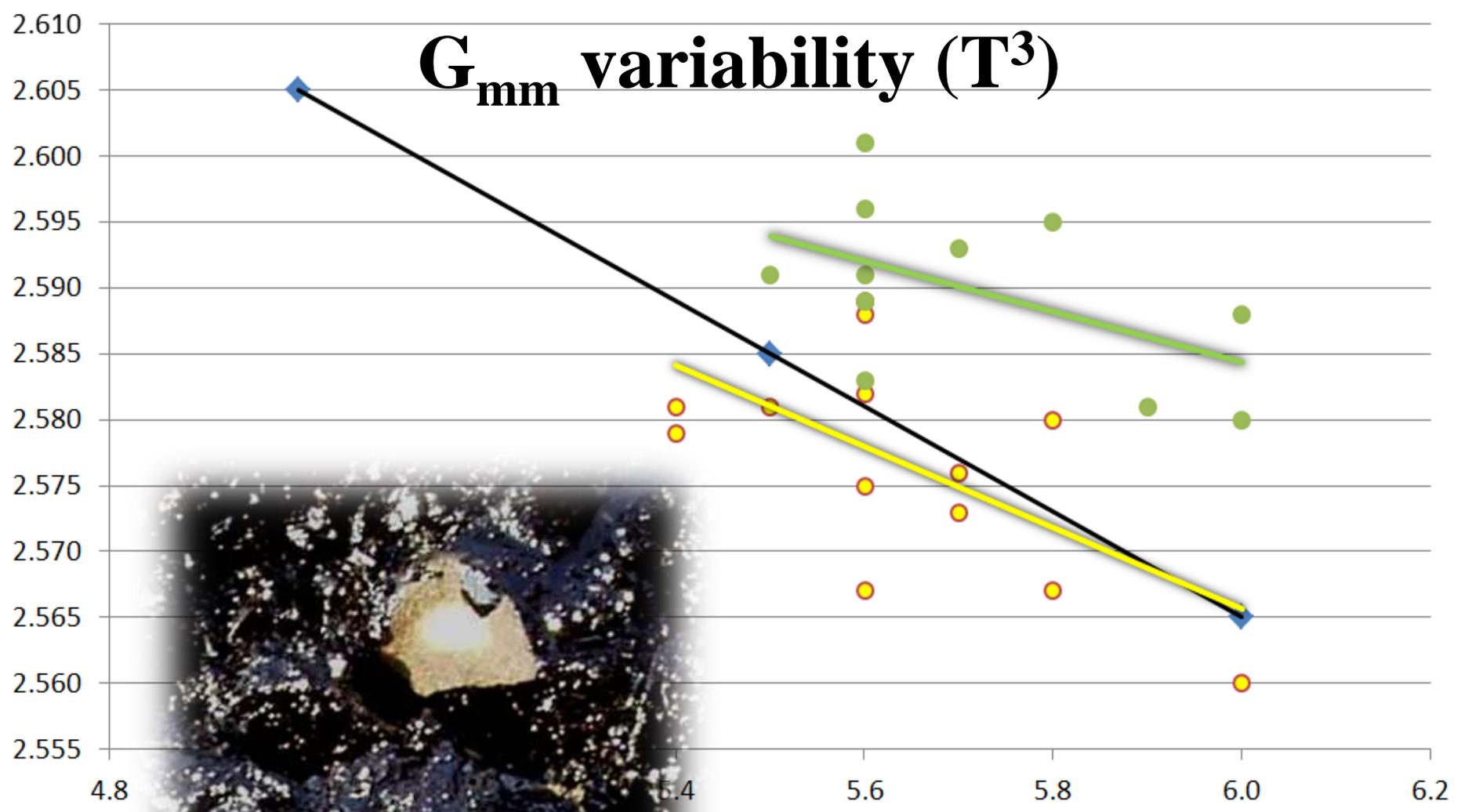
HMA BC N90 19.0R 4740

510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

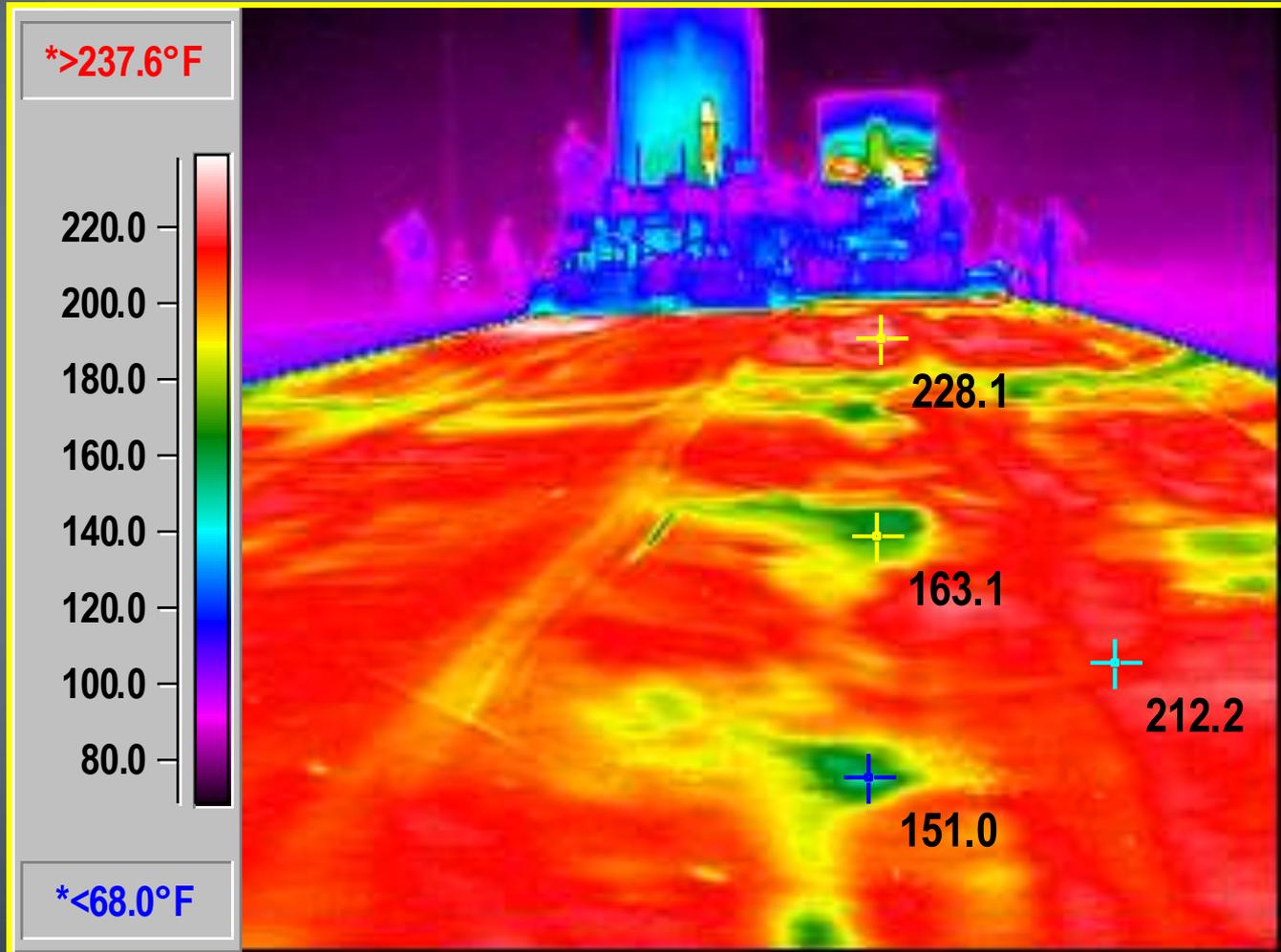
Do not chase the data
Audit the system

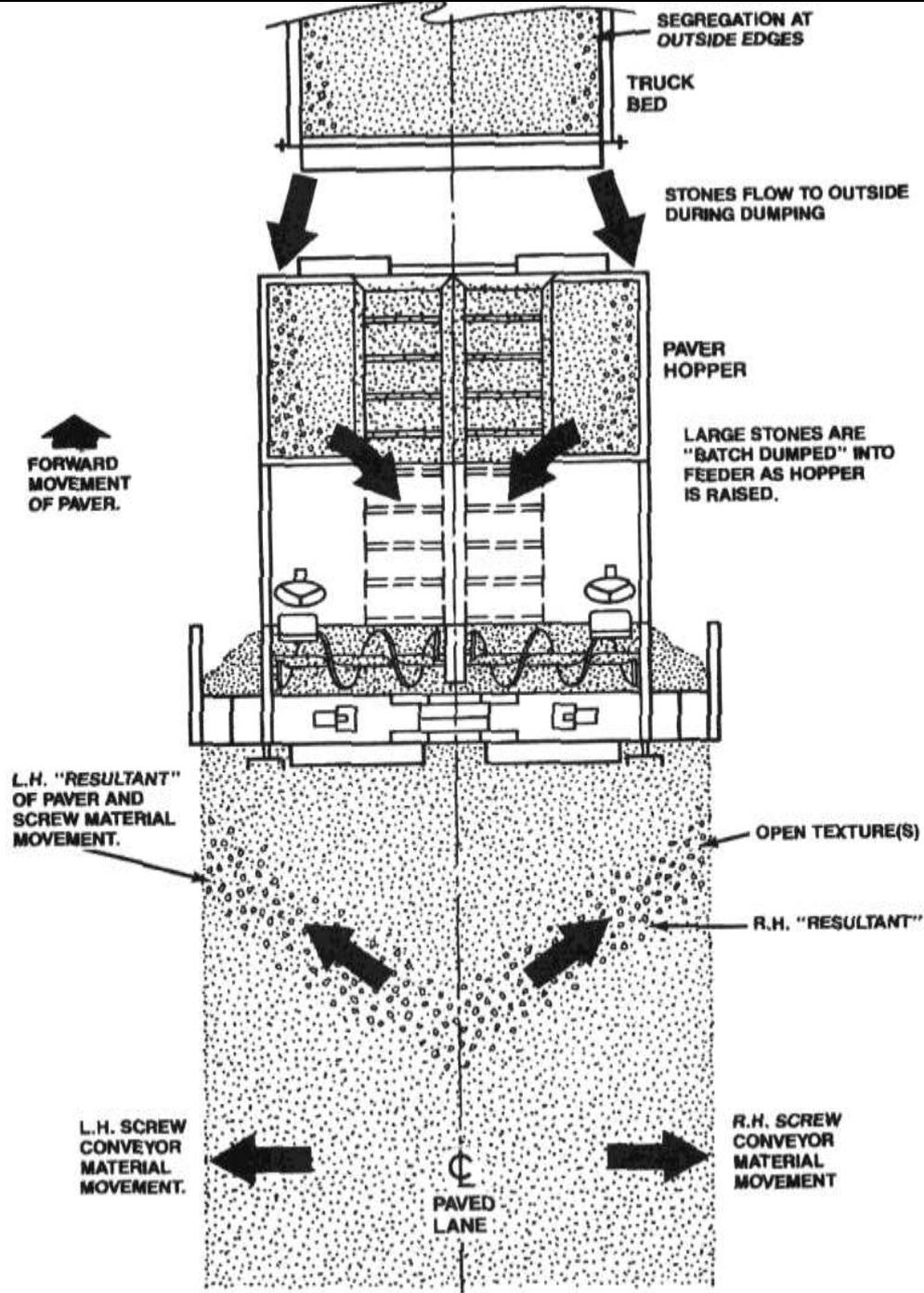


G_{mm} variability (T^3)



Infrared Photo (End Dump Mix Behind Paver)





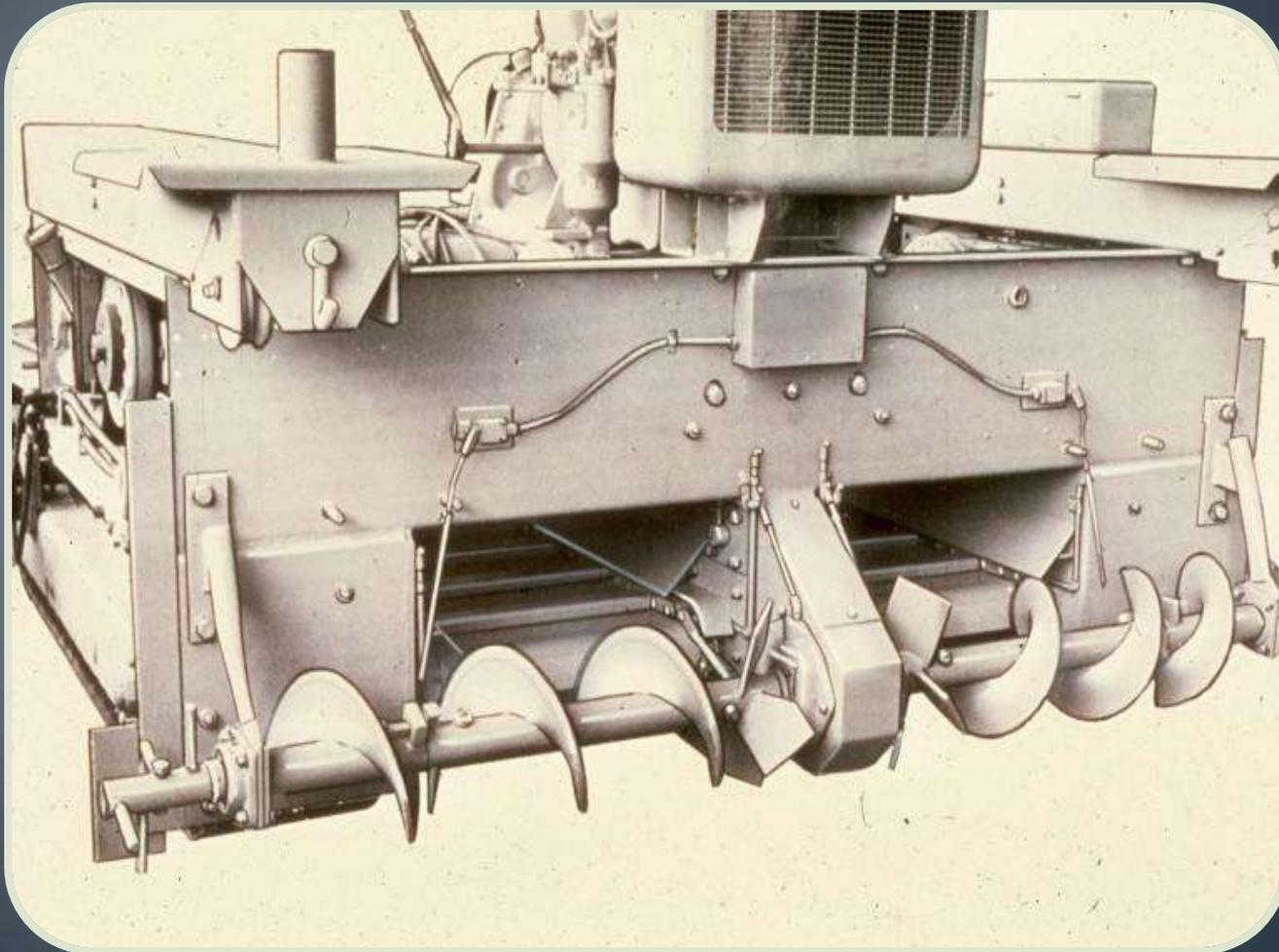
Consider hopper retrofit



Longitudinal Segregation



Kick-Back paddles

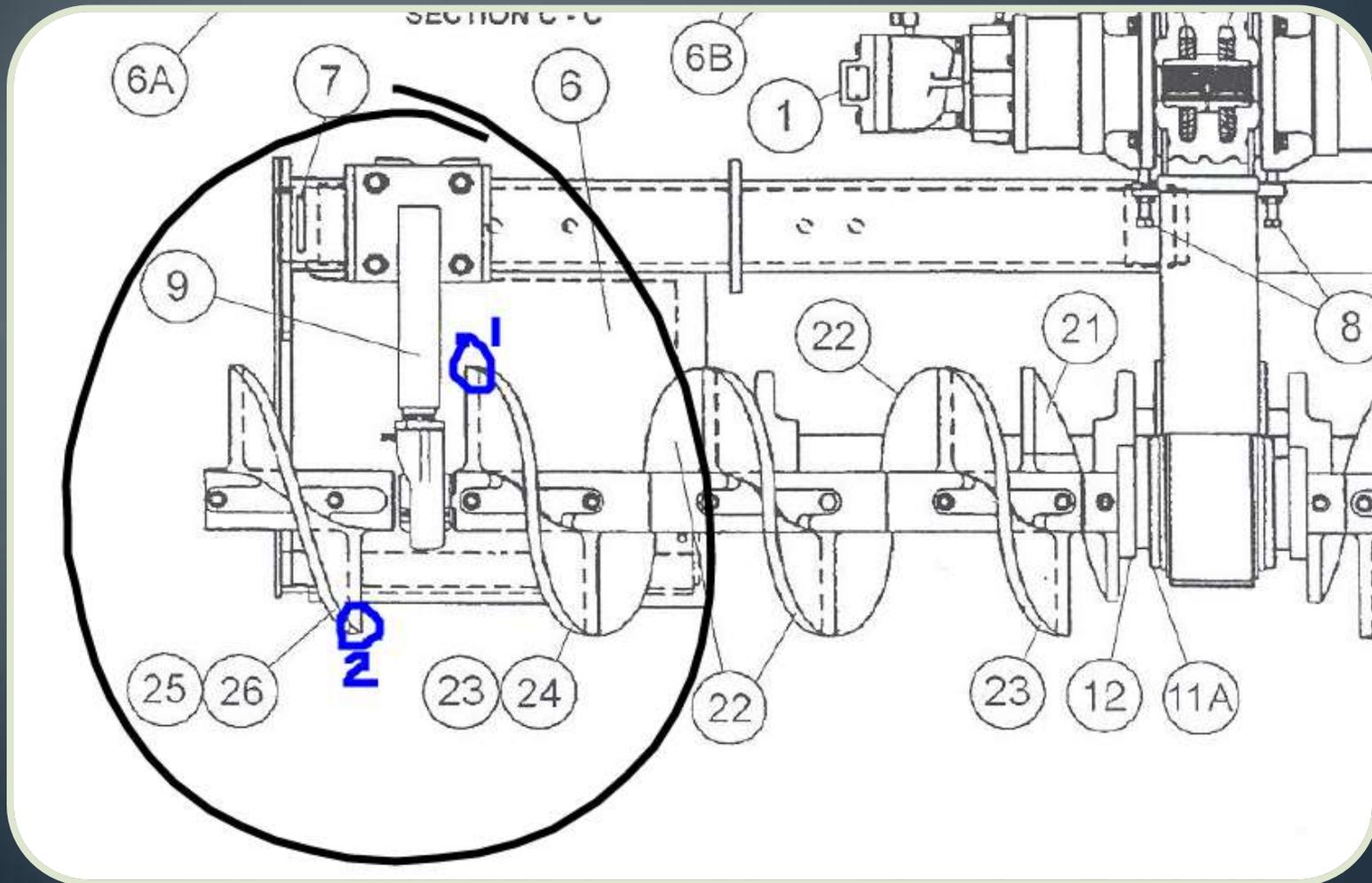


Auger 'hold' point



**My mother always told me,
'The devil is in the details.'**

Bearing / hanger



Density testing





**Think outside the box, cross-train personnel,
and perpetuate contractor ingenuity.**

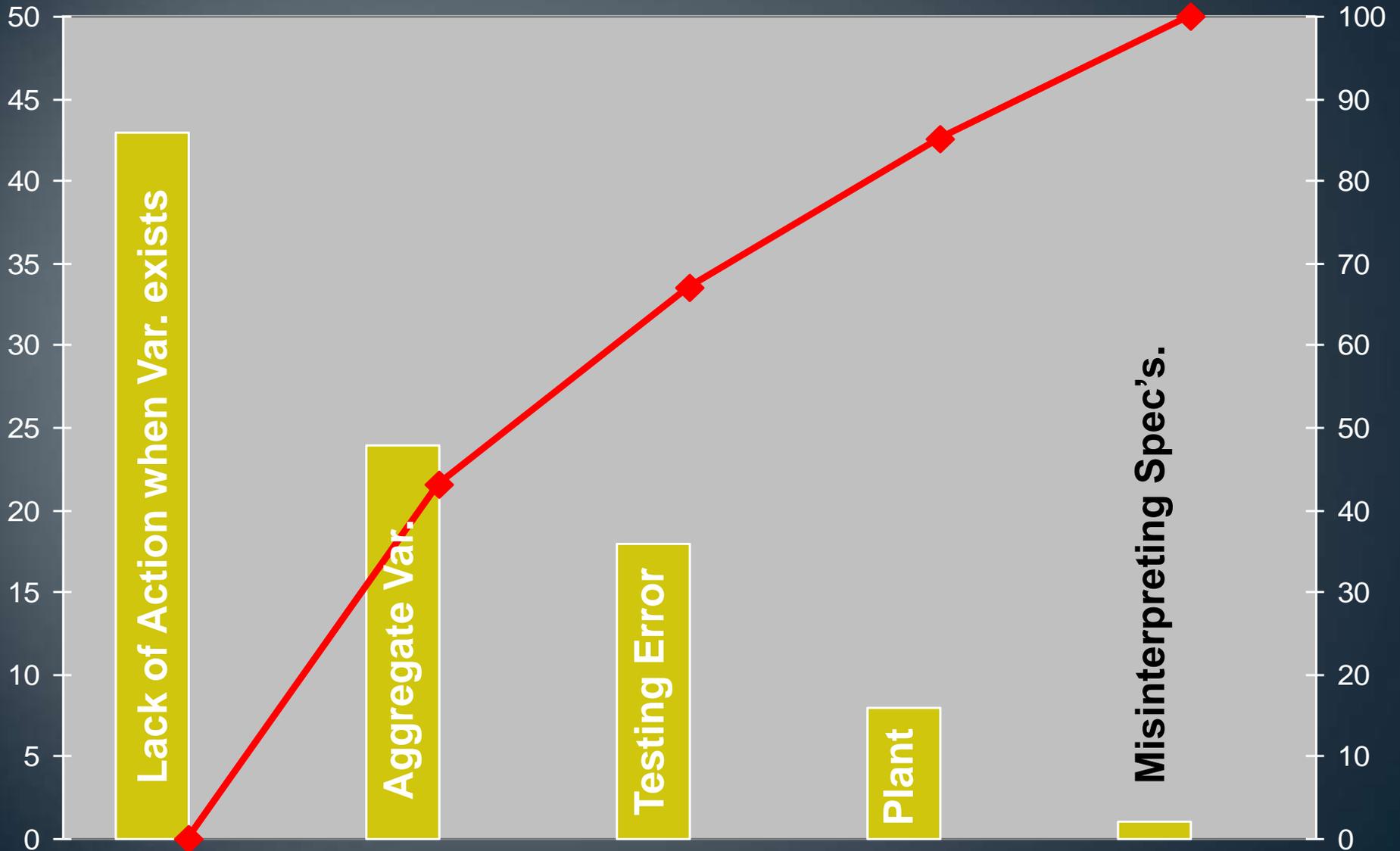
HMA QC Checklist

Project: Interstate 80

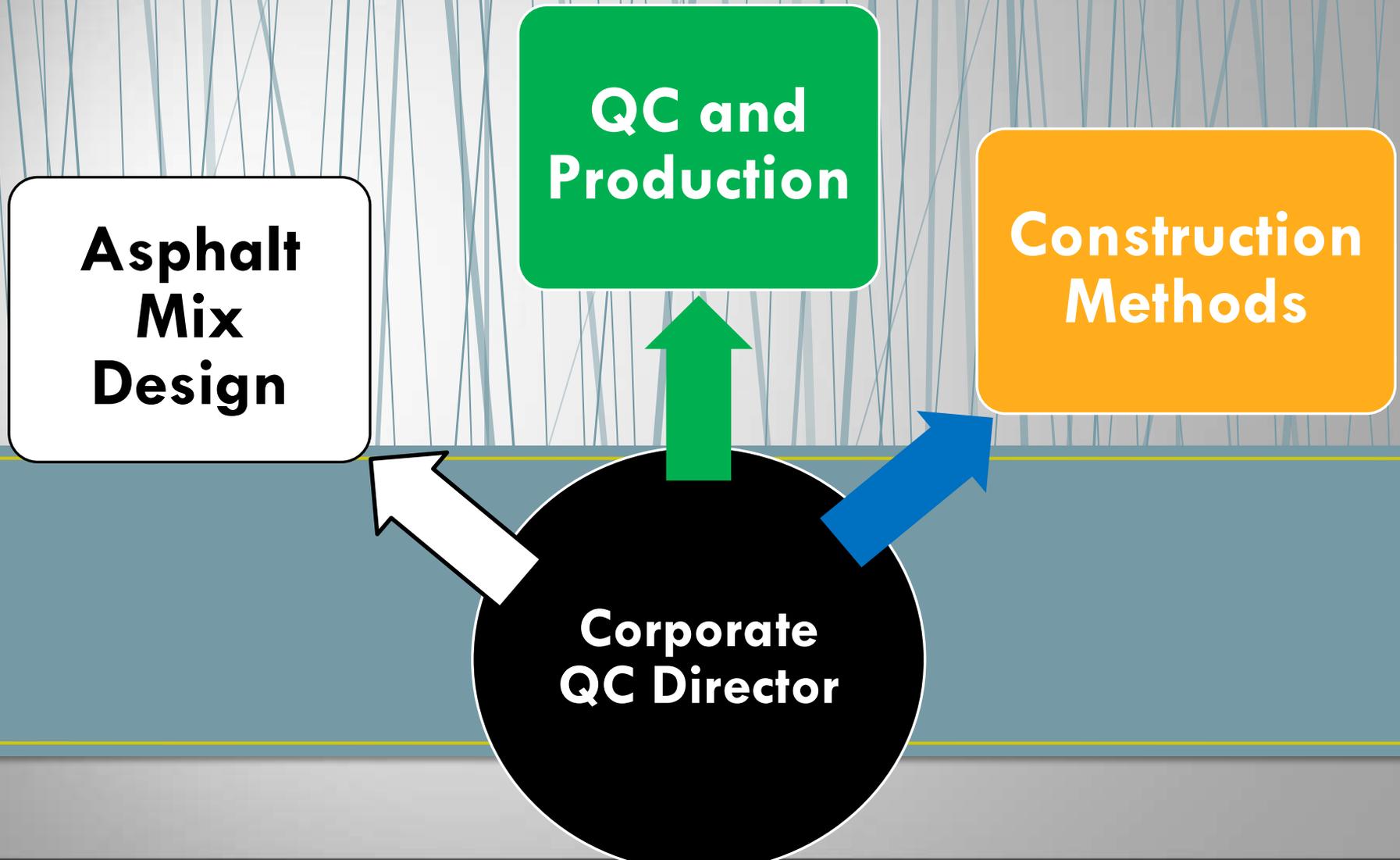
Inspector: Dr. Voids

Problem	Frequency
Varying AC content.	/// (Meet w/Ryan)
Low in-place density.	// (Watch Jt.)
High minus #200.	/// // (Design issue)
Segregation.	/// (Training)
Compromised ride.	// (Spoke w/Pat)

Pareto chart of HMA problems as reported



Maximizing your PWL



New Way of Thinking

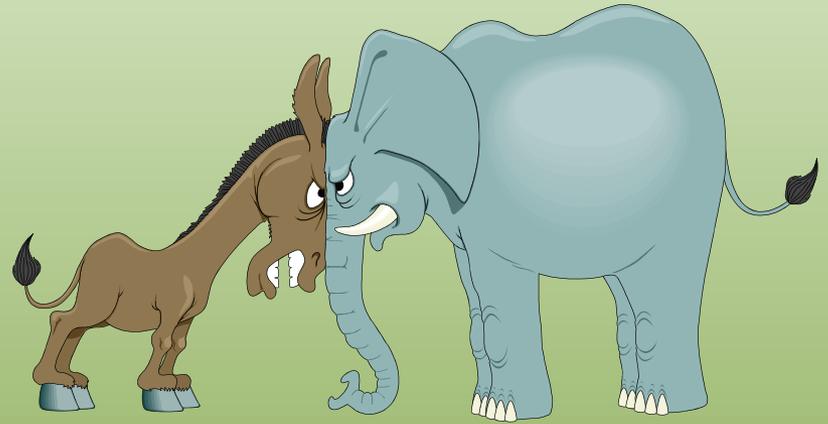
- “Tweaking” mixtures leads to low PWL.
- PWL effects all aspects of operations – everyone is involved with QC – materials, estimating, production, management.



Final Challenge



Questions?



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