Why A Trial Mix Design?

Trial mix designs are needed to provide a mixture having the required properties with the available aggregate at a reasonable, competitive cost.

There are certain considerations to look for in asphalt mix designs:

1. **Stability** of the mix to resist rutting and shoving under a load.
2. **Sufficient voids** for compaction under traffic.
3. **Flexibility** to conform to movement of subgrade.
4. **Fatigue resistance** to withstand repeated bending and flexing due to wheel loads.
5. **Skid resistance** from hard angular aggregate that will not degrade.
6. **Impermeability** to minimize stripping and oxidation.
7. **Durability** from sufficient coating of aggregate particles to resist disintegration from weather and traffic.
8. **Workability** in placing material and the compaction process.

2360 Mix Design Process Outline

1. Aggregate Sample Collection
   a. Provide MnDOT 24 hours notice of intent to collect samples from stockpiles
   b. Collect representative samples for qualities and mix design work (assuming pit has been approved)
2. Contractor Preliminary Aggregate Testing as Needed for Each Material Type
   a. Gradations
   b. Specific Gravity (+#4 and –#4, check 15% rule)
   c. CAA (+#4% crushed)
   d. FAA (or -#4 crushed calculations)
   e. +#4 Spall and Lumps (do not include RAP)
   f. -#4 Shale (do not include RAP)
   g. Los Angeles Abrasion
   h. Soundness
   i. Insoluble Residue
3. Recycled Asphalt Pavement (RAP) Testing
   a. Determine % of old asphalt cement (ac) in RAP
      1. chemical extraction method (3 minimum)
         a. Can be used for specific gravity testing, Gsb
   a. Alternate method for Gsb of RAP
      1. split out 2 representative samples for Rice tests on RAP, see MnDOT lab manual for RAP preparation
      2. use asphalt cement content from average of 3 tests above
      3. calculate Gse, use regression formula for Gsb on RAP
4. Prepare MnDOT Aggregate Submittal samples
   a. MnDOT submittal quality testing (complete pink cards)
      1. at least 15 working days prior to production
      2. at least 30 calendar days if magnesium sulfate test is required
      3. 80 lbs +#4 material (in 2 bags) for qualities (specific gravities, spall, shale, lumps, insoluble residue Class B agg only, etc.)
      4. 35 lbs -#4 material (specific gravities, shale)
      5. need composite RAP for asphalt content & gradation
      6. can use G_{se} and formula for RAP G_{sb}

5. Virgin Aggregate and RAP Preparation
    a. Dry virgin aggregate to constant weight at 230 ± 9°F
    b. Fan dry RAP (do not oven dry RAP for trial points and design)
    c. Determine moisture content of RAP if needed
    d. Size aggregates and RAP into appropriate fractions
    e. Blend fines for homogeneous P200 for each respective aggregate
6. Calculate Aggregate Trial Blends
    a. Check gradation requirements (allow 5-6% from upper and lower limits)
    b. Check composite quality vs. spec's
    c. Plot on 0.45 power chart
    d. may want to include 1% baghouse fines to simulate drop in AFT from degradation
    e. Note Class B aggregate & RAP restrictions
7. Calculations
    a. %-#4 of Composite -#4
    b. Blended -#4 Specific Gravity
    c. Fine Aggregate Angularity on each aggregate to estimate composite value (and do FAA test on blend later if appropriate)
    d. -#4 shale (do not include RAP)
    e. +#4 shale (do not include RAP)
    f. Total Spall (do not include RAP)
    g. +#4 Percent crushed
8. Calculate Aggregate & RAP Batch Weights
9. Batch Aggregates for Trial Points
    a. Heat to mixing temperature
    b. Account for moisture in RAP
    c. Heat RAP minimal amount of time (max 4 hours)
10. Calculate Asphalt Content
    a. Total ac for all virgin blend
    b. New (add) ac for RAP blend
11. Heat Asphalt Cement
    a. Maximum heat time 4 hours
12. Mixing & Curing
    a. Heat ac to recommended mixing temperature (from supplier)
    b. Heating mixing bowl (or bucket) and whip (or paddle)
    c. Dry mix aggregate, form crater
    d. Add asphalt cement
    e. Mix until particles are evenly coated
    f. Cure mixture for 2 hours at 280-300 degrees F

g. Mix points at 15-30 minute intervals

13. Mixture Trial Points
    a. Gyratory tests (check tolerances, 0.020)
    b. Rice tests (check tolerances, 0.011)
    c. Calculate air voids
    d. Calculate Fines/Effective ac
    e. Calculate adjusted film thickness
14. Select Appropriate Aggregate Blend (Job Mix Formula, JMF)
    a. Verify blend meets composite aggregate spec's
    b. Verify blend meets mixture requirements
    c. Is blend economical?
15. Test Acceptable Blend at Additional Asphalt Contents
    a. See Step 13, a through f
16. Calculate Corrected Maximum Gravity
17. Calculate Corrected Air Voids
18. Calculate adjusted film thickness
19. Graph Results
20. Select Optimum (Design) Asphalt Content
21. Perform Lottman Test
22. Cure TSR mixture for 2 hours $\pm$ 15 minutes
23. Perform Testing for Add Rock/Add Sand Provisions as needed
24. Perform Mixture Calibration Tests (Cfm) at Optimum (Design) Asphalt Content
25. Refer to specification for listing of required gyratory mix design data to be included with mix design packet
26. Prepare MnDOT Mixture Submittal
    a. Complete Job Mix Formula submittal packet, include heights printout from gyratory compactor, include Add Sand/Add Rock test data (Gmm, Gmb, Air Voids, AFT, Fines/Eff AC, Gradations at 5% and 10%, FAA, CAA)
    b. Submit 2 design gyratory specimens at optimum asphalt content
    c. Lottman specimens – submit 6 Gyratory samples at 6.5% to 7.5% air voids, and 8,200 grams loose mix (cured, 290 ^{o}F 2 hours) if not submitted when remainder of mix is submitted
    d. 35,000 grams (uncured) mixture at optimum ac
    e. Complete pink MnDOT identification cards, include Pit Number and Legal Description