A.J. Bimrose
Ready Mix Operations Manager
PCC Quality Control Manager
United Contractors Midwest Inc.

Aggregate 101

Stockpiling and Handling

- Fine & Coarse Aggregate
  - Gradation
  - Moisture
  - Breakdown

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IDOT Compliance Issues

- Gradation Sample Fails
  - Resample
- Effects on concrete
  - Finishing Issues
  - Pumping Issues
  - Fine aggregate air entrainment issues
  - Strength issues

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Gradations

- Resamples
- Strength Issues
  - Inconsistent breaks
    - FAA / PWL
- Field issues
  - Finishing issues
    - Will not close up
    - Poor consolidation
  - Pumping issues
    - To Course will plug up pump
    - Causes air entrainment issues

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Inconsistent Moisture in Stockpiles

- Increased Sampling
  - Maintain Slump
  - Maintaining Air Content
  - Concrete Temperature
  - Controlling Water Cement Ratio

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Water Cement Ratio
How much water can we add?

- W/C (Water Cement / Ratio)
  - Workability
    - Increase in water
      - Easier Placement
  - Strength
    - Increased W/C
      - Lower strength
      - Decreased durability
  - Optimum W/C
    - Having sufficient water to fully hydrate the cementitious materials
    - .39 - .41
      - Depending on placement
      - Depending on water demand of cement
      - Depending on admixtures

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Aggregate Breakdown

- Handling at pit or Quarry
  - Stacker
  - Loader
- Handling at plant site
  - Stacker
  - Loader
  - Dozer
- How does this affect Concrete
  - FAA P501
  - Out of Spec with IDOT

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How Concrete adjusts to aggregate

- Total Combined Gradations
  - 3 to 4 aggregate mix designs
    - Plant Capacity
    - Financial Considerations
  - Design with Coarseness Factor
- Moisture Control
  - Additional plant testing
    - Resampling Moistures
  - Moisture Probes
    - Must be calibrated often
- Adjust for Breakdown in mix design
  - Stockpile Samples

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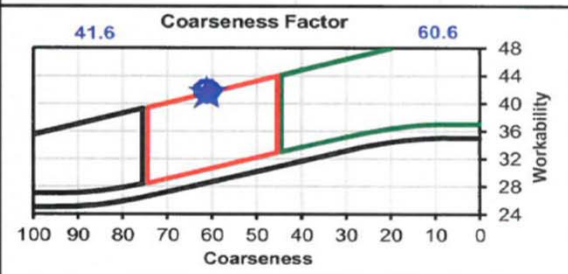
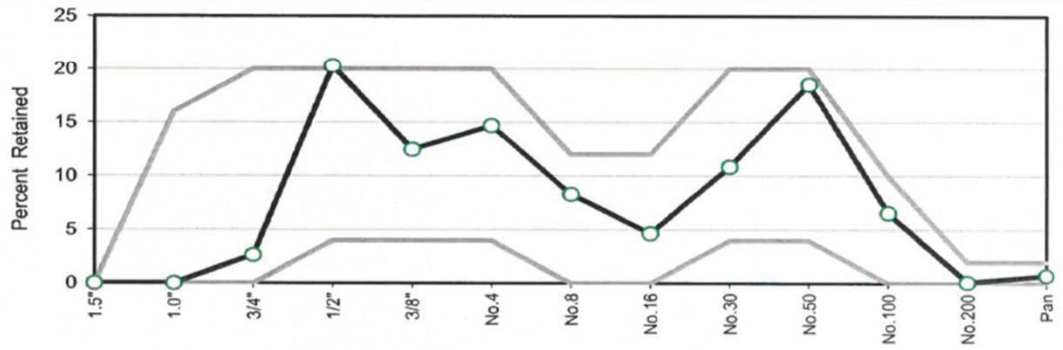
Blended Agg Mix Design

2019-130A			Design PSI (f'_c): 3500			Agg. Gradation Limits	
Aggergate 101			Design Slump: 4"		Placement:	Tarantula by Tyler Ley	
3500 PSI@14 day			Location: Macomb, IL		Truck		
Cementitious Materials	Weight Lbs	Abs. Vol. Cu.Ft.	% Vol.		Cost	**Admixture**	**Oz/yard**	**oz / cwt**
Portland Cement Type I	396	2.01	70.1		--	Daravair 1400		-
F Ash	169	1.06	29.9		--	Recover		-
					--	Daracem 19		-
					--	Mira 35		-
Total Cementitious	565	3.08			--	Daraset 442		-
022CM1101	1391	8.25	44.1%		--			-
022CM1601	383	2.25	12.0%		--			
027FM01	1348	8.21	43.9%	1.00	--			
					--			
					--			
Design Air Content	6.0	1.62			--			
Water: 26.9 Gal	224	3.59			--			
					--			
Total:	**3910**	**27.00**			--			

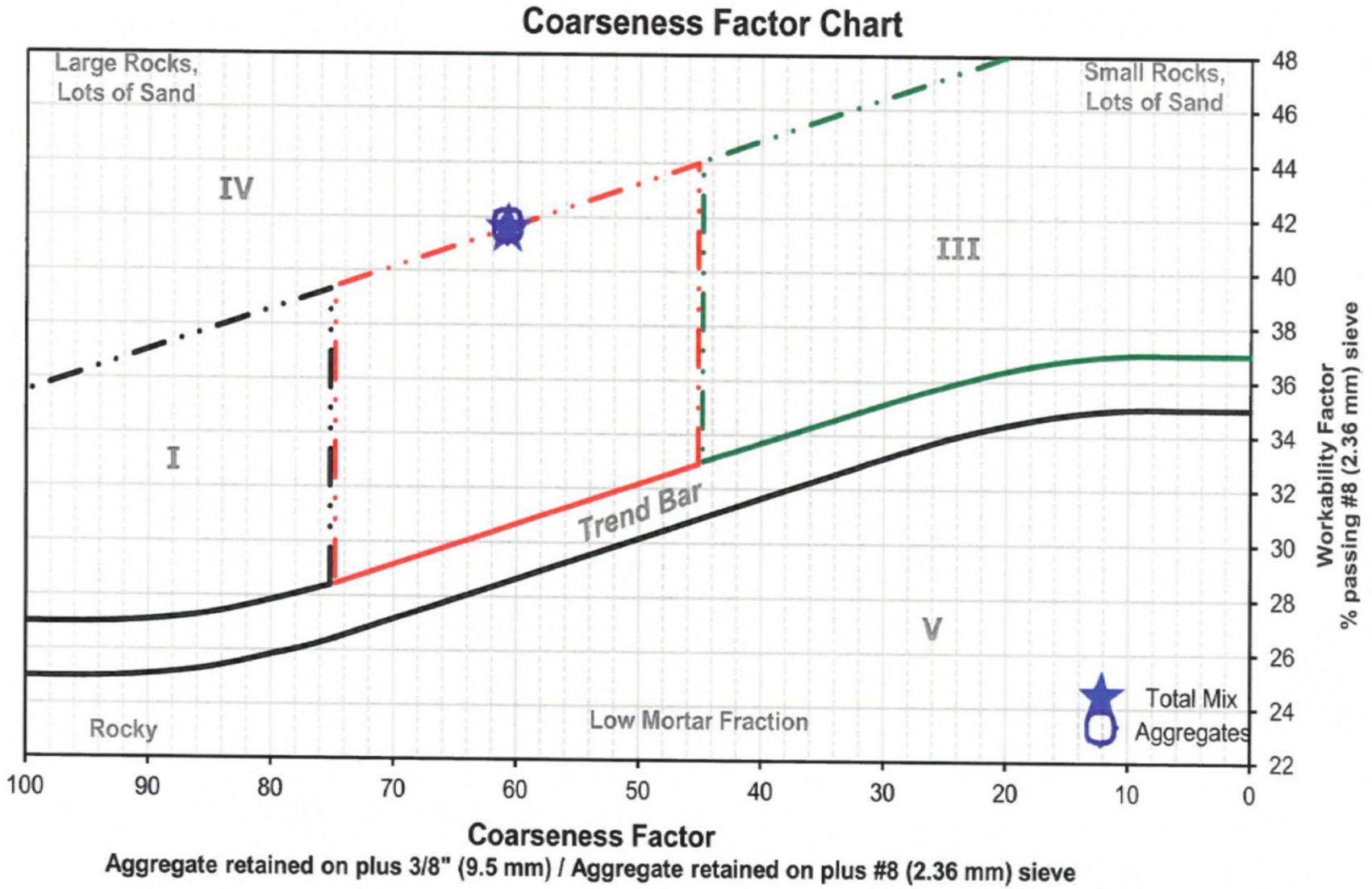


Plastic Density - Cu.Ft.	144.82
Paste Fraction	24.7%
Paste Fraction + Air	30.7%
Mortar Fraction	59.5%
Air Vol / (Cementitious + water)	24.3%
Sand / Agg ratio (Vol)	0.44
Workability Factor (fines)	41.6
Coarseness Factor:	60.6
W-Adj (Workability-Adjustment)	41.6
O.I.F	700
Vol Water / Vol Cemt	1.167
Water/Cementitious Ratio	**0.396**

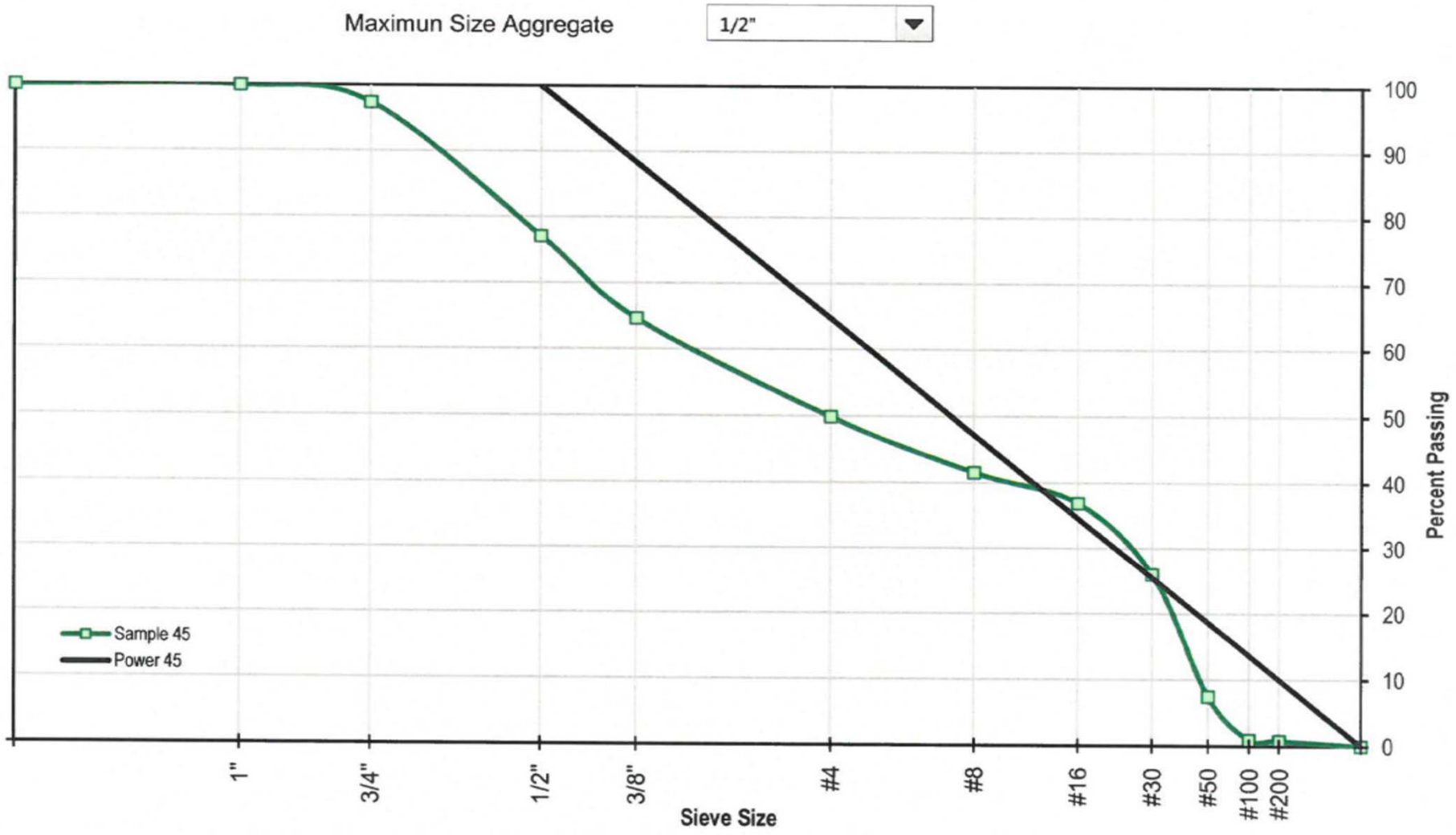


Combined Agg. Blend FM= 4.75 FM of Sand 2.590

Coarseness Factor Chart



Power 45

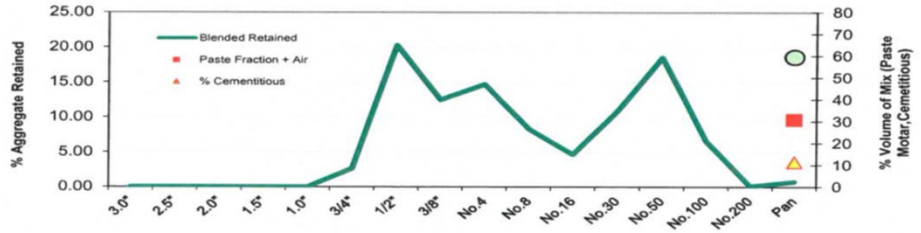

Maximun Size Aggregate
1/2"
100
90
80
70
60
50
40
30
20
10
0
Percent Passing
Sample 45
Power 45
1"
3/4"
1/2"
3/8"
#4
#8
#16
#30
#50
#100
#200
Sieve Size

Gradations

Project:	Aggergate 101	Date:	3/1/2019
Client:	0		
Location:	Macomb, IL		
Mix Code:	2019-130A		
Specified Strength f'c:	3500	Mix Category:	500 PSI@14 day
Design Slump Range:	4"	Placement Method:	Truck
Specified Air Range:	6+-1		

Full Gradation Analysis - Percent Retained

Sieve	022CM1101	022CM1601	027FM01			Total percent passing on each sieve
3.0"	**0.00**	**0.00**	**0.00**			100.0
2.5"	0.00	0.00	0.00			100.0
2.0"	0.00	0.00	0.00			100.0
1.5"	**0.00**	**0.00**	**0.00**			100.0
1.0"	0.00	0.00	0.00			100.0
3/4"	**2.65**	**0.00**	**0.00**			97.4
1/2"	20.29	0.00	0.00			77.1
3/8"	**12.35**	**0.12**	**0.00**			64.6
No.4	**7.06**	**5.89**	**1.76**			49.9
No.8	**0.44**	**4.81**	**3.07**			41.6
No.16	**0.44**	**0.72**	**3.51**			36.9
No.30	**0.66**	**0.12**	**10.09**			26.0
No.50	**0.00**	**0.12**	**18.43**			7.5
No.100	**0.00**	**0.00**	**6.58**			0.9
No.200	-0.26	0.08	0.31			0.8
Pan	0.49	0.16	0.13			0.0
Fineness Modulus:	6.76	5.30	2.59			**4.75 FM**
% of Aggregate (Vol)	44.10%	12.01%	43.88%			
% of Total Mix Volume	30.57%	8.33%	30.41%			69.31%
Aggregate Mass (Lbs)	1391	383	1348			3121
Coarse Aggregat: Q	35.4%				Mortar Fraction:	59.5%
Intermediate: I	23.0%				Paste Fraction:	30.7%
Workability Factor: (Fines W)	41.6%				Coarseness Factor:	60.60%
Cementitious:		Pounds:	Volume	% of CM (Wt)	% of Mix (vol)	% Total
Portland Cement Type I		396	2.01	70.1%	7.46%	Cementitious
F Ash		169	1.06	29.9%	3.93%	by volume
-						**11.40%**
-						
Mix Water =	26.89	gallons	224	pounds	W/cm	**0.396**



Gradations

0	Aggergate 101		2019-130A		03/01/19
Cementitious:		Weight	SG	Volume (lbs/ft^3)	
Portland Cement Type I	Continental Cement Company	396	3.15	2.01	
F Ash	Boral - Havana	169	2.55	1.06	
-	-	-	-	-	
-	-	-	-	-	Aggregate %
Aggregates					Absorption
022CM1101	Riverstone, Cleveland	1391	2.7	8.25	1.00
022CM1601	Riverstone , Cleveland	383	2.73	2.25	1.40
027FM01	Otter Creek S&G Enion	1348	2.63	8.21	0.90
-	-	-	-	-	-
-	-	-	-	-	-
Design Water		224.0	1.00	3.59	
Air Content		6.00 %		1.62	
	Totals:	3910	lbs / yd^3	27.00	Cuft^3

Admixture:	Oz/yd	Oz/Cwt	Water / Cementitious	0.396	
Daravair 1400	0.00	-	Design Density	144.82	lbs/ft^3
Recover	0.00	-			
Daracem 19	0.00	-			
Mira 35	0.00	-			
Daraset 442	0.00	-	**Fiber / Color:**	Amount	Volume
	0.00	-	0	0.00	

	% Passing Each Sieve					Combined	% Retained	
Sieve Size	Agg #1	Agg #2	Agg #3	Agg #4	Agg #5	% Passing	Cum	Indiv
3.0"	100	100	100	-	-	100.0	0.0	0.0
2.5"	100	100	100	-	-	100.0	0.0	0.0
2.0"	100	100	100	-	-	100.0	0.0	0.0
1.5"	100	100	100	-	-	100.0	0.0	0.0
1.0"	100	100	100	-	-	100.0	0.0	0.0
3/4"	94	100	100	-	-	97.4	2.6	2.6
1/2"	48	100	100	-	-	77.1	22.9	20.3
3/8"	20	99	100	-	-	64.6	35.4	12.5
No.4	4	50	96	-	-	49.9	50.1	14.7
No.8	3	10	89	-	-	41.6	58.4	8.3
No.16	2	4	81	-	-	36.9	63.1	4.7
No.30	0.5	3	58	-	-	26.0	74.0	10.9
No.50	0.5	2	16	-	-	7.5	92.5	18.6
No.100	0.5	2	1	-	-	0.9	99.1	6.6
No.200	1.1	1.3	0.3	-	-	0.8	99.2	0.1
							Pan	0.8

Coarseness Factor =	Combined % cumulative retained 3/8" sieve / Combined % cumulative retained #8 sieve	60.60
Workability Factor (WF) =	Combined % passing #8	41.6
Adj-Workability Factor =	WF + [(Cementitious Material - 564) / 37.6]	41.6
Allowable Adj-WF =	Adj - WF = [(11.25-0.15CF)+35.5] $\pm$ 2.5	40.2 High / 35.2 Low

Single Coarse Mix Design

2019-131 A
OSF St. Mary Medical Center
PVSI

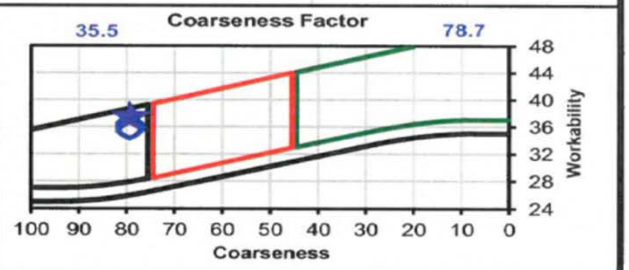
Design PSI (f'_c): 3500
Design Slump: 4"
Location: Knox Co.

Placement: Truck

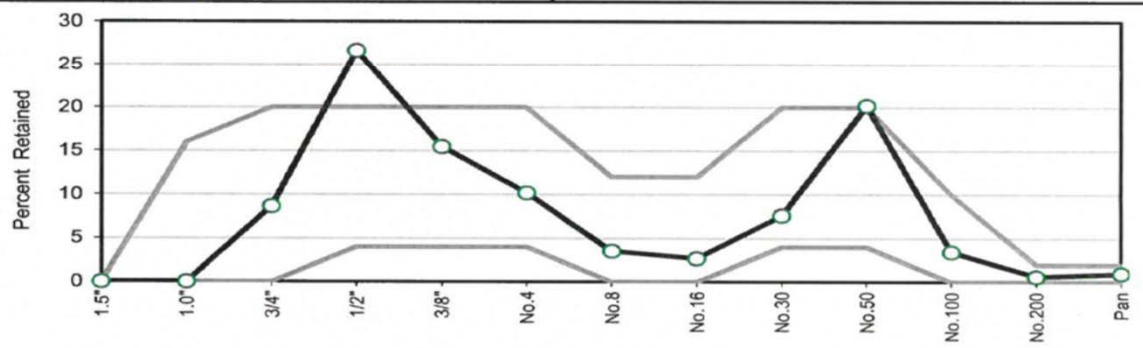
Agg. Gradation Limits: Tarantula by Tyler Ley

Cementitious Materials	Weight Lbs	Abs. Vol. Cu.Ft.	% Vol.		Cost
Portland Cement Type I	475	2.42	74.8		--
C Ash	160	0.94	25.2		--
					--
					--
Total Cementitious	635	3.35			--
022CM1101	1851	10.91	61.9%		--
027FM01	1106	6.72	38.1%	1.00	--
					--
					--
					--
Design Air Content	6.5	1.76			--
Water: 32.0 Gal	267	4.27			--
					--
Total:	**3859**	**27.00**			--

Admixture	Oz/yard	oz / cwt
Daravair 1400 42147		-
Recover 43758		-
Mira 35 43874		-
Daracem 19 43743		-
		-
		-

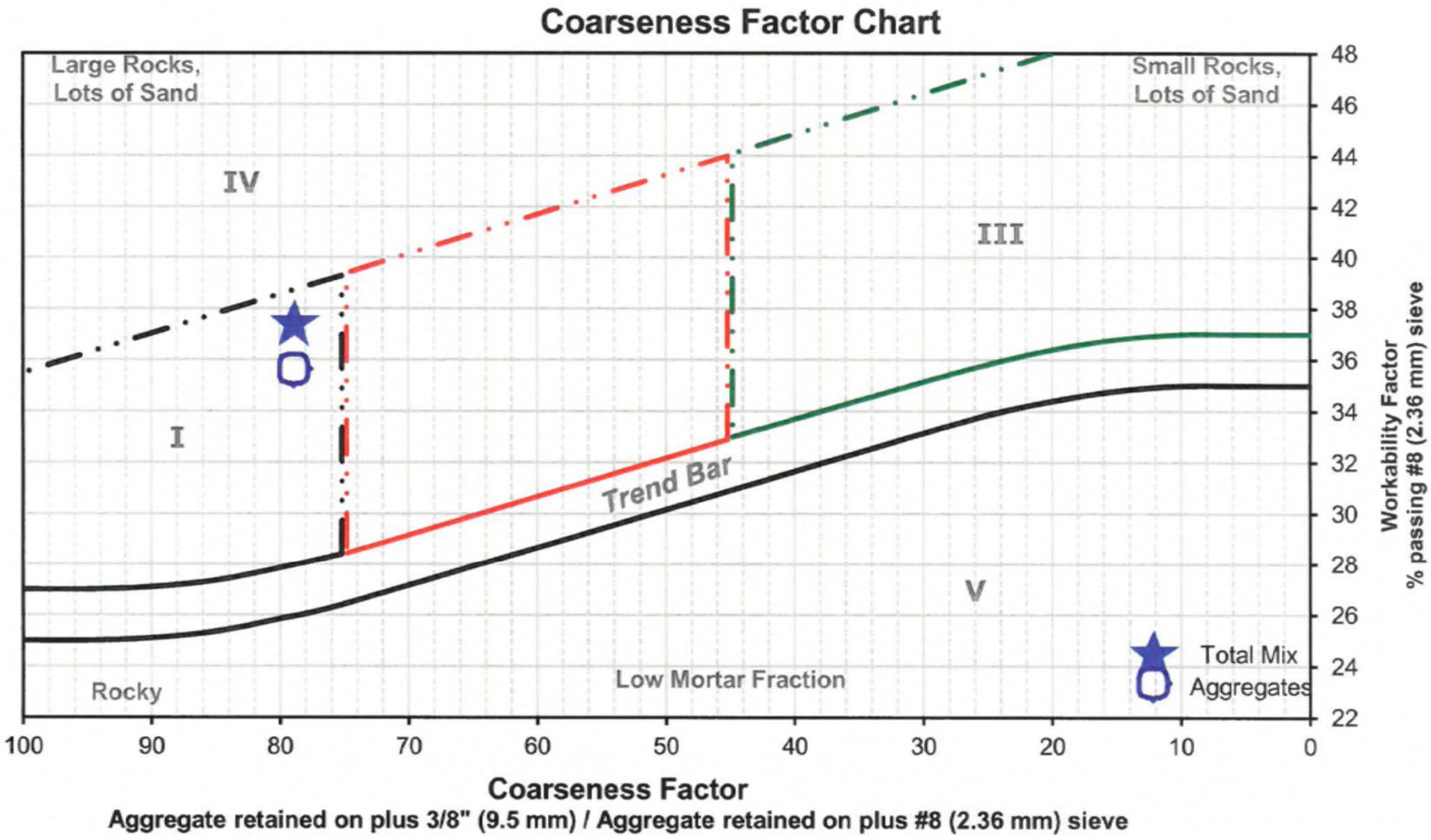


Plastic Density - Cu.Ft.	142.92
Paste Fraction	28.2%
Paste Fraction + Air	34.7%
Mortar Fraction	57.9%
Air Vol / (Cementitious + water)	23.0%
Sand / Agg ratio (Vol)	0.38
Workability **F**actor (fines)	35.5
Coarseness **F**actor:	78.7
W-Adj (Workability-Adjustment)	37.4
O.I.F	847
Vol Water / Vol Cemt	1.274
Water/Cementitious Ratio	**0.420**

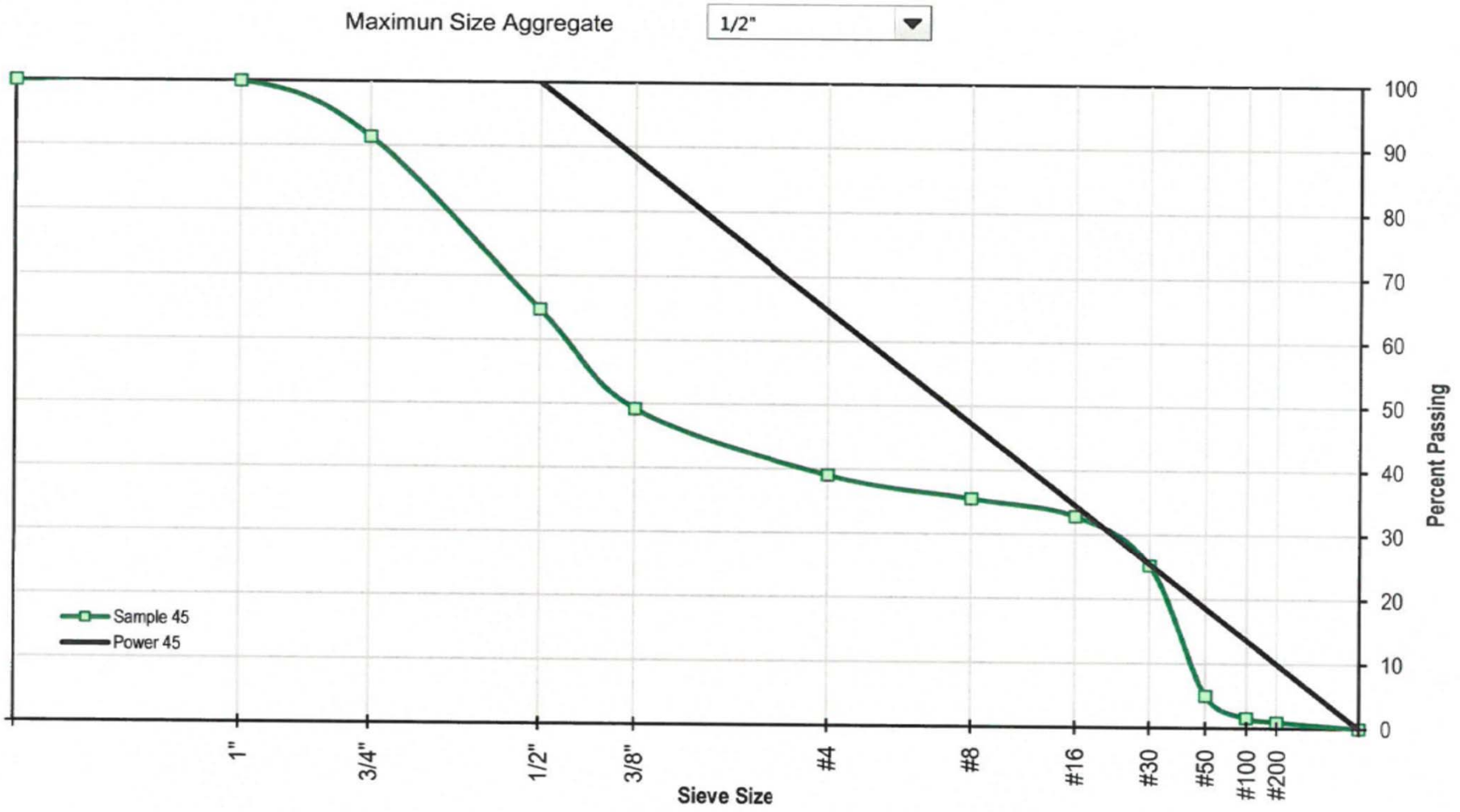


Combined Agg. Blend FM= 5.20 FM of Sand 2.570

Coarseness Factor Chart



Power 45

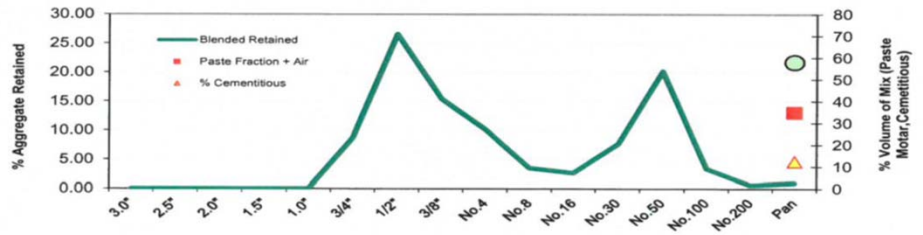

Maximun Size Aggregate
1/2"
100
90
80
70
60
50
40
30
20
10
0
Percent Passing
Sample 45
Power 45
1"
3/4"
1/2"
3/8"
#4
#8
#16
#30
#50
#100
#200
Sieve Size

Gradations

Project:	OSF St. Mary Medical Center	Date:	3/1/2019
Client:	0		
Location:	Knox Co.		
Mix Code:	2019-131 A		
Specified Strength f'c:	3500	Mix Category:	PVSI
Design Slump Range:	4"	Placement Method:	Truck
Specified Air Range:	6.5		

Full Gradation Analysis - Percent Retained

Sieve	022CM1101	027FM01				Total percent passing on each sieve
3.0"	**0.00**	**0.00**				100.0
2.5"	0.00	0.00				100.0
2.0"	0.00	0.00				100.0
1.5"	**0.00**	**0.00**				100.0
1.0"	0.00	0.00				100.0
3/4"	**8.66**	**0.00**				91.3
1/2"	26.61	0.00				64.7
3/8"	**15.47**	**0.00**				49.3
No.4	**8.66**	**1.52**				39.1
No.8	**1.24**	**2.29**				35.5
No.16	**0.00**	**2.67**				32.9
No.30	**0.00**	**7.62**				25.2
No.50	**0.00**	**20.20**				5.0
No.100	**0.00**	**3.43**				1.6
No.200	0.43	0.19				1.0
Pan	0.80	0.19				0.0
Fineness Modulus:	6.82	2.57				**5.20 FM**
% of Aggregate (Vol)	61.89%	38.11%				
% of Total Mix Volume	40.39%	24.87%				65.27%
Aggregate Mass (Lbs)	1851	1106				2957
Coarse Aggregat: Q	50.7%				Mortar Fraction:	57.9%
Intermediate: I	13.7%				Paste Fraction:	34.7%
Workability Factor: (Fines W)	35.5%				Coarseness Factor:	78.73%
Cementitious:		Pounds:	Volume	% of CM (Wt)	% of Mix (vol)	% Total
Portland Cement Type I		475	2.42	74.8%	8.95%	Cementitious
C Ash		160	0.94	25.2%	3.47%	by volume
-						**12.42%**
-						
Mix Water =	31.99	gallons	267	pounds	W/cm	**0.420**



Gradations

0	OSF St. Mary Medical Center	2019-131 A			03/01/19
Cementitious:		Weight	SG	Volume (lbs/ft^3)	
Portland Cement Type I	ontinentail Cement, Hannibal, M	475	3.15	2.42	
C Ash	eadwaters Resources, Havana, I	160	2.74	0.94	
-	-	-	-	-	
-	-	-	-	-	Aggregate %
Aggregates					Absorption
022CM1101	RiverStone, Cleveland IL	1851	2.72	10.91	1.00
027FM01	Otter Creek, Enion, IL	1106	2.64	6.72	0.90
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
Design Water		266.5	1.00	4.27	
Air Content		6.50 %		1.755	
	Totals:	3859	lbs / yd^3	27.00	Cuft^3

Admixture:	Oz/yd	Oz/Cwt	Water / Cementitious	0.420	
Daravair 1400 42147	0.00	-	Design Density	142.92	lbs/ft^3
Recover 43758	0.00	-			
Mira 35 43874	0.00	-			
Daracem 19 43743	0.00	-			
	0.00	-	**Fiber / Color:**	Amount	Volume
	0.00	-	0	0.00	

		% Passing Each Sieve				Combined	% Retained	
Sieve Size	Agg #1	Agg #2	Agg #3	Agg #4	Agg #5	% Passing	Cum	Indiv
3.0"	100	100	-	-	-	100.0	0.0	0.0
2.5"	100	100	-	-	-	100.0	0.0	0.0
2.0"	100	100	-	-	-	100.0	0.0	0.0
1.5"	100	100	-	-	-	100.0	0.0	0.0
1.0"	100	100	-	-	-	100.0	0.0	0.0
3/4"	86	100	-	-	-	91.3	8.7	8.7
1/2"	43	100	-	-	-	64.7	35.3	26.6
3/8"	18	100	-	-	-	49.3	50.7	15.5
No.4	4	96	-	-	-	39.1	60.9	10.2
No.8	2	90	-	-	-	35.5	64.5	3.5
No.16	2	83	-	-	-	32.9	67.1	2.7
No.30	2	63	-	-	-	25.2	74.8	7.6
No.50	2	10	-	-	-	5.0	95.0	20.2
No.100	2	1	-	-	-	1.6	98.4	3.4
No.200	1.3	0.5	-	-	-	1.0	99.0	0.6
							Pan	1.0

Coarseness Factor =	Combined % cumulative retained 3/8" sieve / Combined % cumulative retained #8 sieve		78.73
Workability Factor (WF) =	Combined % passing #8		35.5
Adj-Workability Factor =	WF + [(Cementitious Material - 564) / 37.6]		37.4
Allowable Adj-WF =	Adj - WF = [(11.25-0.15CF)+35.5] ± 2.5	37.4 High	32.4 Low

Production and Quality go hand-in-hand!

- Communication
  - Before, During and After the job is completed
  - Real time reporting
    - Plant
    - Jobsite
- Often I/we have heard how quality slows down production. I feel that with good effective communication, production will increase and our quality will increase too!

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Aggregate 101 Summary

- Fine Aggregate & Coarse Aggregate
  - Gradation
    - IDOT Resample
    - Material Performance
  - Moisture
    - Slump
    - Air
    - W/C
  - Breakdown
    - P501
    - Mix Design Adjustment

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