Q1) An aggregate batch of 1.40 tons of mass and 1 m^3 volume was obtained from an aggregate production facility. It was determined that the oven-dry mass of this aggregate batch was 1.34 tons. In addition, a water absorption test was performed and after the test, the mass of the saturated and surface dry aggregate batch was determined to be 1.36 tons. Determine the moisture content and water absorption values of the aggregate batch. Calculate the amount of excess water on the surface of 950 kg of aggregates taken from this stock.

Solution:

$W_H = 1.40$ t $\qquad W_{OD} = 1.34$ t $\qquad W_{SSD} = 1.36$ t

$$\boldsymbol{H}(\%) = \frac{W_H - W_{SSD}}{W_{SSD}} \times 100 = \frac{1.40-1.36}{1.36} \times 100 = 2.94\%$$

$$\boldsymbol{A_w} = \frac{W_{SSD} - W_{OD}}{W_{OD}} \times 100 = \frac{1.36 - 1.34}{1.34} \times 100 = 1.49\%$$

$$W_o = \frac{950}{1+H} = \frac{950}{1+0.0294} = 922.87\ kg$$

$$\Delta = 950.00 - 922.87 = 27.13\ kg\ excess\ water$$

Q2) The sieve analysis was performed on three groups of dry aggregates and the results are given below. According to the test results:

a) Calculate the percentage passing (P%) of each aggregate.
b) Find the appropriate mix ratio of each aggregate provided that the 45% of the aggregate in the mixture is coarser than 8 mm and 20% of the aggregate in the mixture is finer than 0.5 mm.
c) Check the conformity of the mixing values to the limit values of the reference curves.
d) Plot the grading curve of each aggregate and also the mix aggregate (4 curves in total) on the same graph.
e) Calculate the fineness modulus of the mix aggregate, and interpret the fineness modulus value obtained. Does the fineness modulus give any idea about the gradation of the mixture aggregate?

	Aggregate 1: Natural Sand 1000 g			Aggregate 2: Crushed Stone #1 3000 g			Aggregate 3: Crushed Stone #2 3000 g			MIX AGGREGATE		Dmax = 16 mm		
Sieve size d, (mm)	Amount Retained (g)	Amount Passed (g)	Passing P1 (%)	Amount Retained (g)	Amount Passed (g)	Passing P1 (%)	Amount Retained (g)	Amount Passed (g)	Passing P1 (%)	Passing Pm (%)	100- Pm(%)	A16	B16	C16
31.5	0			0			0					100	100	100
22.4	0			0			0					98	99	100
16	0			90			420					85	92	99
11.2	0			270			1380					68	79	90
8	0			870			660					48	63	77
4	0			840			540					33	49	64
2	140			480			0					22	37	52
1	90			240			0					15	28	41
0.5	250			210			0					10	20	30
0.25	190			0			0					6	13	20
0.15	190			0			0					3	7	11
Ratio in the mix														

Solution:

a)

	Aggregate 1: Natural Sand 1000 g			Aggregate 2: Crushed Stone #1 3000 g			Aggregate 3: Crushed Stone #2 3000 g			MIX AGGREGATE		Dmax = 16 mm		
Sieve size d_i (mm)	Amount Retained (g)	Amount Passed (g)	Passing P1 (%)	Amount Retained (g)	Amount Passed (g)	Passing P1 (%)	Amount Retained (g)	Amount Passed (g)	Passing P1 (%)	Passing Pm (%)	100- Pm(%)	A16	B16	C16
31.5	**0**	1000	100	**0**	3000	100	**0**	3000	100	100	0	100	100	100
22.4	**0**	1000	100	**0**	3000	100	**0**	3000	100	100	0	98	99	100
16	**0**	1000	100	**90**	2910	97	**420**	2580	86	93	7	85	92	99
11.2	**0**	1000	100	**270**	2640	88	**1380**	1200	40	70	30	68	79	90
8	**0**	1000	100	**870**	1770	59	**660**	540	18	55	45	48	63	77
4	**0**	1000	100	**840**	930	31	**540**	0	0	43	57	33	49	64
2	**140**	860	86	**480**	450	15	**0**	0	0	35	65	22	37	52
1	**90**	770	77	**240**	210	7	**0**	0	0	31	69	15	28	41
0.5	**250**	520	52	**210**	0	0	**0**	0	0	20	80	10	20	30
0.25	**190**	330	33	**0**	0	0	**0**	0	0	13	87	6	13	20
0.15	**190**	140	14	**0**	0	0	**0**	0	0	5	95	3	7	11
Ratio in the mix	38.5%			13.3%			48.2%			Total=	536	FM=5.36		

b)

According to the given constraints find the mixing ratios of aggregates

$a + b + c = 1$

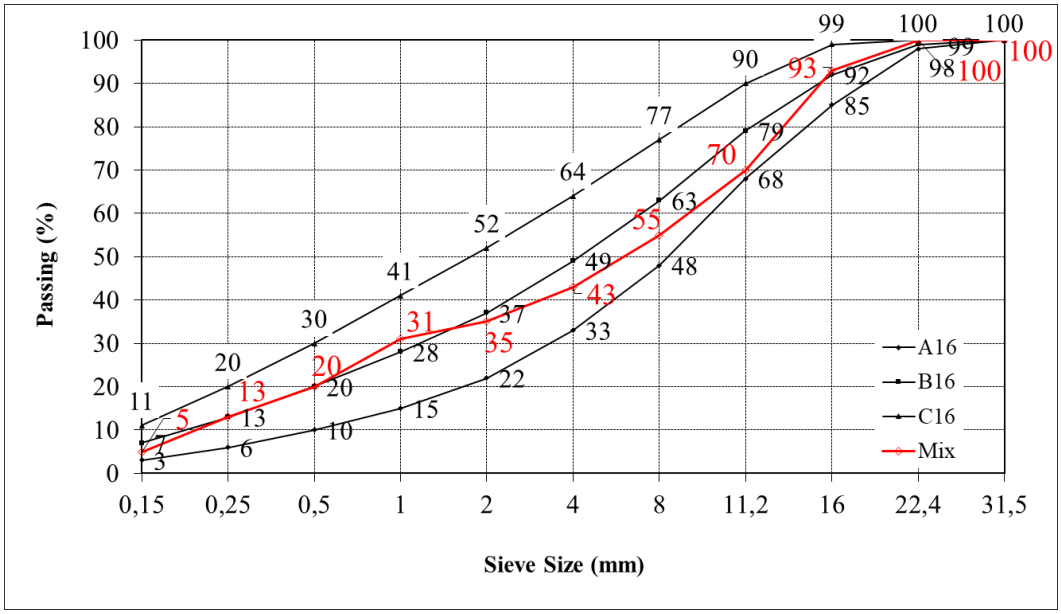
$P_{m,8} = 100\,a + 59\,b + 18\,c = 55$

$P_{m,0.5} = 52\,a = 20$

By using three equations mixing ratios of the aggregates can be calculated.

$a = 38.5\ \%$ $b = 13.3\ \%$ and $c = 48.2\ \%$

c,d) It conforms to the limit (reference) values:



e) $FM_{mix}=5.36$

The fineness modulus of a mixture of aggregates is a measure (index) of the average particle size of the aggregate in the mixture. A higher fineness modulus indicates that the aggregate particles are coarser, while a lower fineness modulus indicates that the aggregate particles are finer. The fineness modulus is used in concrete mix design to ensure that the proportion of fine and coarse aggregate in the mixture is appropriate for achieving the desired strength, workability, and durability of the concrete.

It does not give any idea about the gradation curve, only you can compare the fineness of the different batches of aggregates by using fineness modulus.