APPENDIX – 2
MIX DESIGN OF GEOPOLYMER CONCRETE

Mix Design Calculations

(i) Replacement of Fly ash with GGBFS

Assuming the density of fresh concrete = 2400 kg/m$^3$
Assuming total aggregate content = 75% of 2400 kg/m$^3$
= 1800 kg/m$^3$
Let proportion of fine aggregate = 24% of total aggregate content
= 432 kg/m$^3$
Proportion of coarse aggregate = 76% of total aggregate content
= 1368 kg/m$^3$
Proportion of (GSM + AAS) = 25% of 2400 kg/m$^3$
= 600 kg/m$^3$

Ratio of AAS to GSM = 0.55
Volume of GSM = 600/1.55
= 387 kg/m$^3$
Volume of AAS = 0.55 x 387
= 213 kg/m$^3$

For Alkaline Ratio = 1.0

Ratio of Na$_2$SiO$_3$ to NaOH = 1.0
Volume of NaOH solution = 106.5 kg/m$^3$
Volume of Na$_2$SiO$_3$ solution = 106.5 kg/m$^3$

For Alkaline Ratio = 1.5

Ratio of Na$_2$SiO$_3$ to NaOH = 1.5
Volume of NaOH solution = 85.2 kg/m$^3$
Volume of Na$_2$SiO$_3$ solution = 127.8 kg/m$^3$
(ii) GGBFS based GPC with Natural Aggregates

Assuming the density of fresh concrete = 2400 kg/m$^3$

a) Total Aggregate Content = 72 %

Assuming total aggregate content = 72 % of 2400 kg/m$^3$

= 1728 kg/m$^3$

Let proportion of fine aggregate = 24 % of total aggregate content

= 415 kg/m$^3$

Proportion of coarse aggregate = 76 % of total aggregate content

= 1313 kg/m$^3$

Proportion of (GSM + AAS) = 28 % of 2400 kg/m$^3$

= 672 kg/m$^3$

Ratio of AAS to GSM = 0.50

Volume of GSM

= 672/1.50

≈ 450 kg/m$^3$

Volume of AAS

= 0.50 x 450

= 225 kg/m$^3$

Ratio of Na$_2$SiO$_3$ to NaOH = 2.0

Volume of NaOH solution = 75 kg/m$^3$

Volume of Na$_2$SiO$_3$ solution = 150 kg/m$^3$

b) Total Aggregate Content = 75 %

Assuming total aggregate content = 75 % of 2400 kg/m$^3$

= 1800 kg/m$^3$

Let proportion of fine aggregate = 24 % of total aggregate content

= 432 kg/m$^3$

Proportion of coarse aggregate = 76 % of total aggregate content

= 1368 kg/m$^3$

Proportion of (GSM + AAS) = 25 % of 2400 kg/m$^3$

= 600 kg/m$^3$

Ratio of AAS to GSM = 0.50
Volume of GSM = \frac{600}{1.50} = 400 \text{ kg/m}^3
Volume of AAS = 0.50 \times 400 = 200 \text{ kg/m}^3

Ratio of Na$_2$SiO$_3$ to NaOH = 2.0
Volume of NaOH solution = 66.7 \text{ kg/m}^3
Volume of Na$_2$SiO$_3$ solution = 133.3 \text{ kg/m}^3

c) Total Aggregate Content = 78 %
Assuming total aggregate content = 78 \% of 2400 \text{ kg/m}^3 = 1872 \text{ kg/m}^3
Let proportion of fine aggregate = 24 \% of total aggregate content = 450 \text{ kg/m}^3
Proportion of coarse aggregate = 76 \% of total aggregate content = 1422 \text{ kg/m}^3
Proportion of (GSM + AAS) = 22 \% of 2400 \text{ kg/m}^3 = 528 \text{ kg/m}^3
Ratio of AAS to GSM = 0.50
Volume of GSM = \frac{528}{1.50} \approx 350 \text{ kg/m}^3
Volume of AAS = 0.50 \times 350 = 175 \text{ kg/m}^3

Ratio of Na$_2$SiO$_3$ to NaOH = 2.0
Volume of NaOH solution = 58.3 \text{ kg/m}^3
Volume of Na$_2$SiO$_3$ solution = 116.7 \text{ kg/m}^3
(iii) GGBFS based GPC with Recycled Concrete Aggregates

Assuming the density of fresh concrete  = 2100 kg/m$^3$

Assuming total aggregate content  = 70 % of 2100 kg/m$^3$

= 1471 kg/m$^3$

Let proportion of fine aggregate  = 35 % of total aggregate content

= 515 kg/m$^3$

Proportion of coarse aggregate  = 65 % of total aggregate content

= 956 kg/m$^3$

Proportion of (GSM + AAS)  = 30 % of 2400 kg/m$^3$

= 630 kg/m$^3$

Ratio of AAS to GSM  = 0.50

Volume of GSM  = 630/1.50

≈ 414 kg/m$^3$

Volume of AAS  = 0.50 x 414

= 207 kg/m$^3$

Assuming proportion of Superplasticizer  = 2 % of 414 kg/m$^3$

Volume of Superplasticizer  = 8.3 kg/m$^3$

Ratio of Na$_2$SiO$_3$ to NaOH  = 2.0

Volume of NaOH solution  = 69 kg/m$^3$

Volume of Na$_2$SiO$_3$ solution  = 138 kg/m$^3$