APPENDIX 1

MIX DESIGN

DESIGN OF CONCRETE MIX M30

Grade designation = M30
Characteristic strength \( f_{ck} \) = 30 N/mm\(^2\)
Type of cement = OPC 53 Grade confirming to IS:12269-1987
Maximum size of coarse aggregate = 20 mm (angular)
Degree of workability = 0.90 Compaction Factor
Type of exposure = Mild
Specific gravity of cement = 3.15
Specific gravity of water = 1.00
Chemical admixture = Super Plasticizer
Mineral admixture = Flyash
Specific gravity of coarse aggregate = 2.67
Specific gravity of fine aggregate = 2.62
Water absorption of coarse aggregate = 0.10%
Water absorption of fine aggregate as per codal provisions, = 0.15%
Sand content = 36% of total aggregates

Water cement ratio for M30 concrete = 0.45 (IS : 456, 2000)

From Figure 2 of IS:
10262-1982, select water content = 172 kg

For 20 mm size of aggregates,
maximum water content = 172 kg/m³

Standard deviation (SD) for M30 concrete = 5.00 MPa

Target mean strength = 30 + 1.64 SD
= 30 + 1.64 * 5
= 30 + 8.25 = 38.25 N/mm²

From IS: 456-2000,
Aggregate type = Crushed broken granites

From IS: 10262 for 20 mm size of coarse aggregates
Max. Water content = 186 kg/m³
Hence, Cement content = 172/0.45
= 382 kg/m³ (say 380 kg/m³)

Minimum cement content required = 380 kg

Formula for mix proportion of fine and coarse aggregate,

1000 (1-a₀) = [(Cement content / Sp.gr.of cement) + water content + (Fₐ / sp.gr.* Pₐ)]

1000(1-a₀) = [(Cement content / Sp.gr. of cement) + water content + (Cₐ / sp.gr.* Pₐ)]

Where,
Ca = Coarse aggregate content,  
Fa = Fine aggregate content,  
Pf = Sand content as percentage of total aggregates = 0.40 
Pc = Coarse aggregate content as percentage of total aggregates = 0.64 
\(a_0\) = Percentage of air content,  
As per IS:10262, for 20mm normal size aggregate, 
Entrapped air content is 2\% = 0.02 
Hence,  
\[
1000 \times (1-0.02) = [186+(380/3.15) + (Fa/2.62 \times 0.40)] 
\]

\(Fa\) = 706 kg/m\(^3\) (say 710 kg/m\(^3\))  
\[
1000 \times (1-0.02) = [186+(380/3.15) + (Ca/2.67 \times 0.71)] 
\]

\(Ca\) = 1277 kg/m\(^3\) (say 1280 kg/m\(^3\))  

MIX PROPORTION  
Cement: Sand: Coarse Aggregate: W/C = (380: 710: 1280: 0.45)  
The design mix proportions for the required target strength is as follows,  
Cement: Sand: Coarse Aggregate: w/c = (1: 1.87: 3.37:0.45)