ANNEXURE 1

CONCRETE MIX DESIGN (GRADE M20)

i) Characteristic compressive strength
   Required in the period of 28 days - 20Mpa
   Max. Size of aggregate - 20 mm (angular)
   Degree of workability - 0.90
   Type of exposure - mild

ii) Test data for materials
   Specific gravity of cement - 3.10
   Specific gravity of C.A - 2.65
   Specific gravity of F.A - 2.65

Target mean strength of concrete

The Target mean strength for
  Specified Characteristic cube strength = 20 + (1.65 x 4)=26.6 MPa
  Adopt W/C ratio of 0.45

For change in W/C ratio, compacting factor, for sand belonging to zone II following adjustment is required.

<table>
<thead>
<tr>
<th>Change in condition</th>
<th>Present adjustment required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water content</td>
</tr>
<tr>
<td>For decrease in W/C ratio</td>
<td>0</td>
</tr>
<tr>
<td>For increase in compaction factor</td>
<td>+3</td>
</tr>
<tr>
<td>For sand</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
</tr>
</tbody>
</table>
Water content per cubic on concrete $= 186$ kg
Sand constant as percentage of total aggregate $= 35\%$

Therefore required sand content as percentage of total aggregate by absolute volume.

$$= 35-3.0$$
$$= 32.0\%$$

Required water content $= 186+3$

$$= 189 \text{ l/m}^3$$
$$= 189 \text{ l/m}^3 (\text{approximately})$$

Determination of cement content

\[
\begin{align*}
\text{W/C ratio} & = 0.45 \\
\text{Water} & = 189 \\
C & = \frac{189}{0.45} = 420 \text{ kg/m}^3
\end{align*}
\]

Determination of coarse and fine aggregate concrete:

\[
\begin{align*}
V & = (W+C/S + l/p f_a/s_{fa}) \times 1/1000 \\
0.99 & = (189+(420/3.10)+(1/0.305)(f_a/2.65)*(1/1000)) \\
& = 189 + 135.48 + 1.180 f_a \\
F_a & = 564 \text{ kg/m}^3 \\
C_a & = \frac{1-p}{P} \times \frac{F_a \times S_{ca}}{S_{fa}} \\
C_a & = 1-0.32/0.32 \times 530 \times 2.68/2.65 \\
& = 2.125 \times 564 \times 1.011 \\
& = 1121.68 \text{ kg/m}^3
\end{align*}
\]

**MIX PROPORTION**

<table>
<thead>
<tr>
<th>Water</th>
<th>Cement</th>
<th>Fine aggregate</th>
<th>Coarse aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>189</td>
<td>420</td>
<td>564</td>
<td>1121.68</td>
</tr>
<tr>
<td>0.45</td>
<td>1</td>
<td>1.26</td>
<td>2.88</td>
</tr>
</tbody>
</table>