Use of Fly ash in Road Construction

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Types of Coal Ash

- **Fly Ash**
  Replacement of Cement in concrete, Stabilisation in Mortar, RCCP, Light weight concrete, etc

- **Bottom Ash & Pond ash**
  Embankment Fill Material, Agricultural Applications, Stabilisation

- **Mound ash, Pulversied fuel ash**

"Fly ash" is common name for any type of coal ash
Utilisation of Fly Ash for Road Works

- Can be used for construction of
  - Embankments and backfills – Reinforced or unreinforced
  - Stabilisation of subgrade, sub-base and base course
  - Concrete Pavement, Paver blocks, Cell filled concrete, Khadanza

- Fly ash properties vary, to be characterised before use

- **Major constituents** – Oxides of silica, aluminum, iron, calcium and magnesium

- **Environmentally safe material** for road works

- Possesses **many favourable properties** for embankment & road construction

- Usage is mandated by Government of India
DO IT YOURSELF
RURAL ROADS CONSTRUCTION USING FLY ASH

http://pmgsy.nic.in/public.asp
<table>
<thead>
<tr>
<th>Plant</th>
<th>District</th>
<th>Utility</th>
<th>Capacity (MW)</th>
<th>Fly ash generation (Million Tonnes/Year)</th>
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<tbody>
<tr>
<td>Anpara</td>
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<td>UPRVUNL</td>
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<td>Harduaganj</td>
<td>Aligarh</td>
<td>UPRVUNL</td>
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<tr>
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<td>Sonbhadra</td>
<td>UPRVUNL</td>
<td>1194</td>
<td>1.3</td>
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<tr>
<td>Panki</td>
<td>Kanpur</td>
<td>UPRVUNL</td>
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<td>Parichha</td>
<td>Jhansi</td>
<td>UPRVUNL</td>
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<td>Rihand</td>
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<td>Singaruli</td>
<td>Sonbhadra</td>
<td>NTPC</td>
<td>2000</td>
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<tr>
<td>Tanda</td>
<td>Ambedkar Nagar</td>
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<td>440</td>
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<td>Plant</td>
<td>District</td>
<td>Utility</td>
<td>Capacity (MW)</td>
<td>Fly ash generation (Million Tonnes/Year)</td>
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<tr>
<td>Dadri</td>
<td>G.B.Nagar</td>
<td>NTPC</td>
<td>1820</td>
<td>2.6</td>
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<tr>
<td>Unchahar</td>
<td>Raebareli</td>
<td>NTPC</td>
<td>1050</td>
<td>1.9</td>
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<tr>
<td>Barkhera</td>
<td>Pilibhit</td>
<td>BEPL (IPP)</td>
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<td>Kundarki</td>
<td>Gonda</td>
<td>BEPL (IPP)</td>
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<tr>
<td>Maqsoodpur</td>
<td>Shahjahanpur</td>
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<td>0.2</td>
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<tr>
<td>Utraula</td>
<td>Balrampur</td>
<td>BEPL (IPP)</td>
<td>90</td>
<td>0.2</td>
</tr>
<tr>
<td>Rosa Phase I</td>
<td>Shahjahanpur</td>
<td>RPSCL (IPP)</td>
<td>1200</td>
<td>1.3</td>
</tr>
</tbody>
</table>
Favourable Properties of Fly Ash for Road Construction

- Lightweight as compared to commonly used fill material (local soils), therefore, fly ash causes lesser settlements. It is specially useful for embankment construction over weak sub-soils (clayey sub-soils) where excessive weight of embankment may cause failure.

- Usually pond ash and bottom ash have higher California Bearing Ratio (CBR) as compared to soil, which can lead to less pavement thickness.

- Pozzolanic hardening property imparts additional strength to the road pavements/embankments.

- Amenable to stabilisation using cement or lime.
Favourable Properties of Fly Ash for Road Construction....Contd

- Can be compacted over a wide range of moisture content, and therefore, results in lesser variations in density with changes in moisture content.
- Easy to handle and compact because the material is lightweight and there are no large lumps to be broken, fly ash is available in powdered form.
- Can be compacted using either vibratory or static rollers.
- Offers greater stability of slopes due to higher angle of friction. Value of angle of internal friction increases even more upon compaction.
- Considerably low compressibility results in negligible subsequent settlement within the fill.
Favourable Properties of Fly Ash for Road Construction....Contd

- High permeability ensures free and efficient drainage. After rainfall, water gets drained out quickly ensuring better workability than soil, especially during monsoons. Work on fly ash fills/embankments can be restarted within a few hours after rainfall, while in case of soil it requires much longer time period.

- Faster rate of consolidation; a major part of decrease in volume occurs during primary consolidation phase, which is generally rapid, thus making it an ideal material for embankment fills.

- Conserves good earth (embankment) and aggregates (Pavement), thereby protecting the environment.
## Differences Between Indian & US Fly Ashes

<table>
<thead>
<tr>
<th>Property compared</th>
<th>Indian fly ash</th>
<th>US fly ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss on ignition (Unburnt carbon)</td>
<td>Less than 2 per cent</td>
<td>5 to 8 per cent*</td>
</tr>
<tr>
<td><strong>SO₃ content except Assam</strong></td>
<td>0.1 to 0.2 per cent</td>
<td>3 to 4 per cent</td>
</tr>
<tr>
<td>CaO content</td>
<td>1 to 3 per cent</td>
<td>5 to 8 per cent</td>
</tr>
<tr>
<td>Ash content</td>
<td><strong>Higher (30 to 50 per cent)</strong></td>
<td><strong>Lower</strong></td>
</tr>
<tr>
<td>Increase in concentration of heavy metals</td>
<td>3 to 4 times in comparison to source coal</td>
<td>10 times or more in comparison to source coal</td>
</tr>
<tr>
<td>Rate of leaching</td>
<td>Lower</td>
<td>Higher</td>
</tr>
</tbody>
</table>

* In US, coal burning temperature is kept lower to reduce NOₓ
# Engineering Properties of Fly Ash & Soil

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Fly ash*</th>
<th>Sand</th>
<th>Silt</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific gravity</td>
<td>1.90 – 2.55</td>
<td>2.65 – 2.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plasticity index</td>
<td>NP</td>
<td>NP</td>
<td>NP – 17</td>
<td>&gt; 17</td>
</tr>
<tr>
<td>Compaction test- MDD(gm/cc)</td>
<td>0.90 – 1.60</td>
<td>1.75 – 1.84</td>
<td>1.52 – 2.00</td>
<td>1.45 – 1.80</td>
</tr>
<tr>
<td>Optimum moisture content (%)</td>
<td>38.0 – 18.0</td>
<td>15 – 9</td>
<td>18 – 10</td>
<td>30 – 15</td>
</tr>
<tr>
<td>Angle of internal friction ((\phi))</td>
<td>30° – 40°</td>
<td>28° – 45°</td>
<td>25° – 35°</td>
<td>0° – 10°</td>
</tr>
<tr>
<td>Cohesion (kN/m²)</td>
<td>Negligible</td>
<td>0</td>
<td>10 – 25</td>
<td>30 – 60</td>
</tr>
<tr>
<td>Compression index ((C_c))</td>
<td>0.05 – 0.4</td>
<td>–</td>
<td>0.05 – 0.15</td>
<td>0.30 – 2.60</td>
</tr>
<tr>
<td>Permeability (cm/sec)</td>
<td>(10^{-3} – 10^{-5})</td>
<td>(10^{-2} – 10^{-4})</td>
<td>(10^{-5} – 10^{-7})</td>
<td>(10^{-7} \text{ or Less})</td>
</tr>
<tr>
<td>Particle size distribution</td>
<td>Clay size fraction (%)</td>
<td>Sand size fraction (%)</td>
<td>Silt size fraction (%)</td>
<td>Gravel size fraction (%)</td>
</tr>
<tr>
<td></td>
<td>1 – 10</td>
<td>7 – 90</td>
<td>4.75 – 0.075 mm</td>
<td>0 – 10</td>
</tr>
<tr>
<td></td>
<td>8 – 85</td>
<td></td>
<td>0.075 – 0.002 mm</td>
<td>Less than 0.002 mm</td>
</tr>
</tbody>
</table>

*Fly ash property range from IRC SP:58 and MORD Specifications*
Fly ash Usage for Embankment Construction
Guidelines for Use of Fly Ash in Road Embankments (IRC SP:58)

MORD Specifications Clause 306
Section 306  MORD Specifications
Fly ash Embankment Construction

- Fly ash embankment to have appropriate side cover
- Construction to conform to IRC SP:58
- Fly ash shall cover all types of coal ash such as pond ash, bottom ash or mound ash
- Test results for Engineer approval – Particle size analysis and Standard proctor compaction test
- Material for side cover to conform to section 301
- Dry ash to be conditioned with water and transported in covered trucks
Section 306  MORD Specifications
Fly ash Embankment Construction...Contd

- Loose layer thickness – 200 mm (static roller) upto 400 mm (vibratory roller)
- Embankment to be compacted to 98% of MDD (Min)
- Top of embankment to be covered by 500 mm thick earth cover out of which 300 mm shall be subgrade
- Side slope erosion needs to be controlled by providing soil cover (Minimum Cover thickness – 300 mm for rural roads, 500 mm for other category roads)...Technology Initiative Guidelines
- Fly ash embankment shall be measured separately for (a)soils used for cover and intervening layers (b)Fly ash
Guidelines for Use of Fly Ash in Road Embankments (IRC SP:58)

- Design considerations are similar to earthen embankments.
- FOS should be 1.25 (Minimum) under normal conditions, 1.0 (Minimum) under seismic / saturated conditions.
- Density of compacted fly ash would be considerably lower than soil, fly ash with low MDD values not to be rejected.
- Ash has no cohesion (c), $\phi$ should be basis for design.
- Very little possibility of liquefaction of fly ash embankment.
- Indian fly ash has lower $SO_3$ and lesser heavy metal content.
- Earth cover to prevent erosion and water ingress.
Guidelines for Use of Fly Ash in Road Embankments (IRC SP:58)...

- Cover thickness – 1 m (upto 3 m high embankments), cover can be upto 3 m for high embankments
- Intermediate soil layer if embankment height more than 3 m
- Minimum thickness of intermediate soil layer – 200 mm
- Embankment construction similar to earthen embankments
- Loose layer thickness can be upto 400 mm if vibratory roller is used, loose layer can be upto 200 mm if 8-10 ton static roller is used
- Soil cover and ash to be compacted simultaneously
Fly ash Embankment
Case Studies
Approach Embankment for Second Nizamuddin Bridge at Delhi

- Embankment Length – 1.8 km, height – 6 to 9 m
- Ash utilised - 1,50,000 m³, Opened to traffic in 1998
- Adverse site condition – Located in flood prone area
- Apprehensions before construction – Low specific gravity of ash, Non availability of performance data, design procedure or construction specifications
- Instrumentation installed showed very good performance of embankment
- Savings to Delhi PWD due to usage of fly ash is about Rs.1.00 Crore, additional savings to Vidyut Board
- Saving of precious top soil
Approach Embankment for Second Nizamuddin Bridge at Delhi
Utilisation of Fly ash for Four Laning Work on NH-6 (Dankuni to Kolaghat)

- Length of road – 54.4 km, Height of embankment – 2 to 4 m
- Water logged area, soft sub-soil condition
- Fly ash utilisation – about 4 million tonnes
- Embankment constructed using mixture of pond ash & sand
High Embankment Using Fly ash on Soft Ground – Kalindi Bypass Project

- Length of embankment – 4.5 km in Delhi Yamuna river bed
- Height varies from 5 m to 9 m
- Soft slush of thickness 0.5 to 3 m exist in sub-soil
- No ground improvement measures adopted due to usage of fly ash
Fly ash Embankment at Wazirabad

- Construction of approach embankment for Wazirabad Bridge at Delhi – **Fly ash being used as fill material in waterlogged area**
- **Huge savings in construction cost** due to usage of fly ash instead of granular material in waterlogged area
- **Reinforced earth wall of 6 m height to be constructed over 10.3 m high unreinforced fly ash embankment**
Construction of Embankment
## Environmental Acceptability

<table>
<thead>
<tr>
<th>Contaminant (mg/kg) ppm</th>
<th>BTPS Pond ash</th>
<th>Rajghat Pond ash (No. 1)</th>
<th>Rajghat Pond ash (No. 2)</th>
<th>River bed Soil sample (No. 1)</th>
<th>River bed Soil sample (No. 2)</th>
<th>Limits as specified for Hazardous Materials by MOEF, GOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>23</td>
<td>43</td>
<td>83</td>
<td>40</td>
<td>23</td>
<td>5000</td>
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<tr>
<td>Cadmium</td>
<td>01</td>
<td>BDL</td>
<td>01</td>
<td>01</td>
<td>01</td>
<td>50</td>
</tr>
<tr>
<td>Chromium</td>
<td>55</td>
<td>113</td>
<td>76</td>
<td>115</td>
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<td>Zinc</td>
<td>104</td>
<td>105</td>
<td>98</td>
<td>102</td>
<td>80</td>
<td>20,000</td>
</tr>
<tr>
<td>Lead</td>
<td>14</td>
<td>24</td>
<td>80</td>
<td>20</td>
<td>16</td>
<td>5000</td>
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</tbody>
</table>

BDL – 1 mg/kg

Guru Vittal
Fly ash for Road Pavement Construction
Fly Ash is a Better Road Pavement Material Because,

- **Non plastic** in nature, Coarser ashes (Pond ash and Bottom ash) have **high CBR value**
- **Pozzolanic property**, Amenable to stabilisation
- Lignitic ashes have self-hardening property
- **Ease of compaction**, Compacted using vibratory or static roller
- Can be used for pavement construction in the form of:
  - Cement, lime or mechanically stabilised fly ash
  - Roller compacted concrete
  - Fly ash admixed concrete pavements
  - Precast block paving, Cell filled concrete pavement, Khadanaza
  - White topping, Panelled Concrete pavement

Fly ash Can be Used as Non Plastic Filler in WBM/ WMM and GSB Layers
Fly Ash as a Pozzolanic Material

- Fly ash reacts with lime in presence of water to form cementitious compounds – Pozzolanic Property
- Pozzolanic property enables fly ash to replace cement
- Both anthracitic and lignitic fly ashes are pozzolanic, lignitic fly ash can also be hydraulic to limited extent
- When fly ash is disposed in water slurry form, much of its pozzolanic property is lost
- Hence pond ash and bottom ash are not generally suitable for cement replacement or for lime stabilisation
- IS 3812 (Part 1) provides property requirements for fly ash to be considered as a pozzolanic material
Effect of Fly Ash in Fresh Concrete

- Reduction in heat of hydration
- Improvement in workability
- Decrease in water demand, reduced bleeding
- Lesser segregation and improved cohesiveness

Effect of Fly Ash in Hardened Concrete

- Increased ultimate strength
- Reduced permeability
- Improved durability
- Reduction in corrosion and alkali-silica reactivity
- Sulphate and Chloride penetration resistance even in aggressive environment
Effect of Fly Ash Usage in Concrete

Cement Reaction: $C_3S + H \ (\text{Hydration}) \rightarrow C-S-H + CaOH$

Pozzolanic Reaction: $CaOH + S \rightarrow C-S-H$

$S \ (\text{Silica}) \ \text{From Fly ash}, \ C-S-H \rightarrow \text{Calcium Silicate Hydrate}$

- OPC Grade 43 and 53 have higher proportion of $C_3S$ and low amount of $C_2S$, due to which high initial strength is ensured but quantity of free lime leached is more, hence fly ash usage is more beneficial for Grade 43 and 53.

- For using as concrete admixture – Mix to be redesigned based on improvement in workability.

- Usage is economical and environment friendly.

- Limitations – Lower early strength, Unsuitable under freezing temperatures, May interfere with retarders, Water reducers, etc.
Provisions in Codes/ Specifications

- Fly ash content can be up to 30 per cent by weight of cementitious material. If fly ash is used, cement content in concrete shall not be less than 270 kg/cubic m. The cementitious material content shall not be more than 450 kg/cubic m nor less than 350 kg/cubic m (Plain cement concrete pavement and RCCP – MORD Specifications)
- Physical properties of fly ash to conform to IS 3812 Part 1
- 20 to 50 per cent replacement of cement allowed in RCCP – IRC SP: 68
- Fly ash upto 20 per cent by weight of cementitious material (cement+Fly ash) can be used along with 43 and 53 grade OPC (MORTH Specifications)
- IS 456 ‘Code of Practice for Plain and Reinforced Cement Concrete’ allows upto 35 per cent replacement of cement by fly ash
Section 1503 & 1504
Rectangular Concrete Block Pavement/ ICBP

- Cement Content – Similar to PQC
- Rectangular Block Pavements – Sub-Base 100 mm Min (WBM/Granular), Base 75 mm Min (WBM G2 or G3)
- ICBP – Sub-Base 100 mm Min, Base 100 mm Minimum
- ICBP Block thickness – 60 mm upto 100 VPD Traffic, 80 mm for 100 to 250 VPD Traffic, 2 Wheelers not to be counted Rectangular Block thickness – 150 mm
- Concrete – M 30, Water absorption – 6% (Max) for ICBP
Khadananza (Fly ash Brick Paving)

- 315 mm x 150 mm x 150 mm FalG blocks for paving (Fly ash + Lime or cement + Gypsum + Sand or Stone dust)
- Bricks are prepared earlier, So faster rate of laying
- Environmentally better choice, no burning during brick making, better strength of bricks (20 MPa)
- Khadananza keeps gaining strength after wetting
- Khadananza Cost (Wearing course) about Rs.28 lakh per km (sub-base and subgrade preparation cost extra)
- Construction is similar to paver blocks, mortar can be laid between joints to prevent pilferage

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Khadanza

Ref: https://www.youtube.com/watch?v=A0v9W1CecvQ
Stabilisation Using Fly Ash

- Stabilised soil subgrade & sub-base/base courses
  - Mixing with soil reduces plasticity of subgrade
  - Addition of small percentage of lime or cement greatly improves strength
  - Leaching of lime is inhibited and durability improves due to addition of fly ash
- Pond ash and bottom ash can also be stabilised
## Requirement of Soil Stabilisation Techniques

<table>
<thead>
<tr>
<th>Technique</th>
<th>Applicability for different soil types</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mechanical Stabilisation</strong></td>
<td>Sands, moorums/gravels having <strong>missing fractions</strong> and clayey soils</td>
</tr>
<tr>
<td><strong>Lime Stabilisation</strong></td>
<td><strong>Medium and heavy clays</strong> having PI &gt; 10 and containing atleast 15% material finer than 425 micron</td>
</tr>
<tr>
<td></td>
<td>sieve. Soil whose UCS increases by at least 0.3 Mpa with lime treatment</td>
</tr>
<tr>
<td><strong>Cement Stabilisation</strong></td>
<td><strong>Granular soils</strong> with organic content not more than 2% or deleterious salts not more than 0.2%, Plasticity product (PI x % passing 425 μ sieve ) should be less than 250 and uniformity coefficient &gt; 5</td>
</tr>
<tr>
<td><strong>Lime – Fly ash Stabilisation</strong></td>
<td>Soils of medium plasticity (PI between 5 to 20) and clayey soils not reactive with lime</td>
</tr>
<tr>
<td><strong>Two-Stage (Lime-Cement) Stabilisation</strong></td>
<td><strong>Heavy clays</strong> with PI &gt; 30</td>
</tr>
</tbody>
</table>

*Section 408*
Combining Pond ash & Soil Based on Grain Size

<table>
<thead>
<tr>
<th>Numerical Difference between Material A and Average</th>
<th>Material A “Soil” Per cent Passing</th>
<th>Sieve Size (mm)</th>
<th>Sub-Base Gradation Limits (MORD Specs)</th>
<th>Average</th>
<th>Material B “Pond Ash” Per cent Passing</th>
<th>Numerical Difference between Material B and Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
<td>37.5</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>0</td>
</tr>
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<td>10</td>
<td>100</td>
<td>19</td>
<td>80 – 100</td>
<td>90</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>32.5</td>
<td>100</td>
<td>9.5</td>
<td>55 – 80</td>
<td>67.5</td>
<td>100</td>
<td>32.5</td>
</tr>
<tr>
<td>50</td>
<td>100</td>
<td>4.75</td>
<td>40 – 60</td>
<td>50</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>76.5</td>
<td>99</td>
<td>0.425</td>
<td>15 – 30</td>
<td>22.5</td>
<td>69</td>
<td>46.5</td>
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<tr>
<td>73.5</td>
<td>81</td>
<td>0.075</td>
<td>0 – 15</td>
<td>7.5</td>
<td>9</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>242.5</strong></td>
<td><strong>98</strong></td>
<td><strong>0.075</strong></td>
<td><strong>0 – 15</strong></td>
<td><strong>7.5</strong></td>
<td><strong>9</strong></td>
<td><strong>1.5</strong></td>
</tr>
</tbody>
</table>

Pond ash:Soil = 242.5:140.5 (1.7:1)
Pond ash = \((242.5 \times 100) / (242.5 + 140.5)\) = 63%
# Properties of Stabilised Raichur Pond ash

<table>
<thead>
<tr>
<th>Mix Proportions (per cent)</th>
<th>OMC (%)</th>
<th>MDD(kN/m³)</th>
<th>CBR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 % Pond ash</td>
<td>22.5</td>
<td>14.4</td>
<td>22</td>
</tr>
<tr>
<td>15% BC Soil + 85% Pond ash</td>
<td>29.6</td>
<td>12.8</td>
<td>40</td>
</tr>
<tr>
<td>25% BC Soil + 75% Pond ash</td>
<td>23.0</td>
<td>13.1</td>
<td>34</td>
</tr>
<tr>
<td>67% BC Soil + 33% Pond ash</td>
<td>18.0</td>
<td>16.3</td>
<td>4</td>
</tr>
<tr>
<td>100% BC Soil</td>
<td>27.0</td>
<td>14.1</td>
<td>2</td>
</tr>
<tr>
<td>15% BC Soil + 82% Pond ash + 3% Lime</td>
<td>30.0</td>
<td>12.7</td>
<td>105</td>
</tr>
<tr>
<td>33% Gravel + 67% Pond ash</td>
<td>16.2</td>
<td>17.1</td>
<td>45</td>
</tr>
</tbody>
</table>
Case Studies
Demonstration Road Project – Raichur

- Total length of the demo road – 1 km (Completed in 1997)
- Five sections of 200 m each with different pavement sections
- Pond ash has been used for replacing moorum in sub-base course and to replace WBM layer by adopting stabilisation technique
- Rigid pavement section using DLFC and RCCP technology was laid
- Performance of all the specifications is good
Demonstration Road at Raichur

Mixing of lime stabilised Sub-base

Mix being laid for compaction
Demonstration Road at Raichur

Material Laid for Compaction

Compaction of Stabilised Pond ash
Demonstration Road Project Using Fly Ash Near Dadri (U.P.)

- RCCCP wearing course: 0.1 m
- Stabilised fly ash base: 0.1 m
- Soil cover: 0.3 m thick
- Stabilised fly ash shoulder
- Bottom ash
Demonstration Road Project Using Fly Ash Near Dadri (U.P.)

Stabilised base course

Mixing & laying of RCCP

Mixing of RCCP
Road Project Using Fly Ash Near Dadri (U.P)

Compaction of RCCP
सारांश

- तीन प्रकार - फ्लाई ऐश, बॉटम एश, और पॉण्ड एश
- IRC SP 72 एवं MORD Specifications में संशोधन किया है, अब फ्लाई ऐश के उपयोग के लिए पर्याप्त गुंजाइश
- सूखा फ्लाई ऐश (IS 3812 Part 1) प्रतिक्रियाशील है – कंक्रीट पेमेंट में OPC के बदले (upto 30%) इस्तेमाल करिए
- बॉटम एश और पॉण्ड एश – तटबंध (फ़िल), GSB एवं Base course में गैर प्लास्टिक सामग्री जैसे उपयोग
- फ्लाई ऐश को Stabilise करिए और सड़क निर्माण में इस्तेमाल करिए
- पर्यावरण की दृष्टि से सुरक्षित, लागत की बचत एवं सरकारी निर्देशों के अनुसार

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Fly Ash Usage in Road Works

- Three types – Fly ash, Bottom ash and Pond ash
- IRC SP 72 & MORD Specifications have been revised, Ample scope for fly ash usage in new specifications
- Usage – Fill material, Stabilisation, Cement Concrete
- Dry fly ash (IS 3812 Part 1) is reactive – Can replace part of cement in concrete pavement
- Pond ash and bottom ash – Embankment fill, usage in GSB and Base course as a non plastic material
- Stabilise fly ash and build road pavements
- Usage is environmentally safe, economical and as per Government Directives

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Thank you
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