

Mainstreaming the use of Green Construction Materials in Rural Roads in India

Arnab Bandyopadhyay
Lead Transport Specialist
World Bank
abandyopadhyay@worldbank.org

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- II. Gaps in Indian practice and SWOT analysis
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I. Use of Green Construction Technology and Materials and Rural Roads

Key Considerations

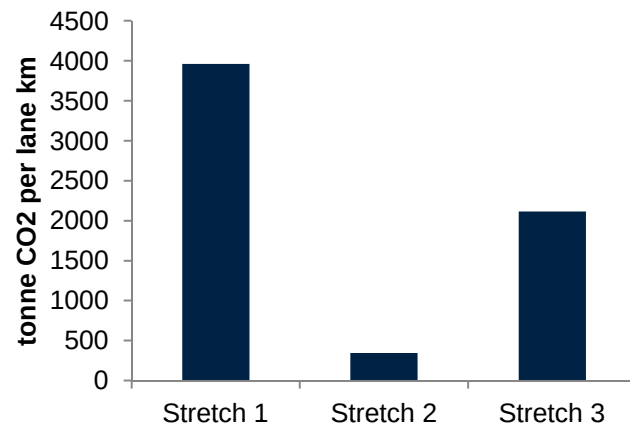
- ❖ To promote cost effective and fast construction.
- ❖ To promote environment friendly “Green Technologies”.
- ❖ To expand the “working season”.
- ❖ Guidelines to States and Codes issued by National Rural Roads Development Agency (NRRDA) & Indian Roads Congress (IRC).

Immediate Focus

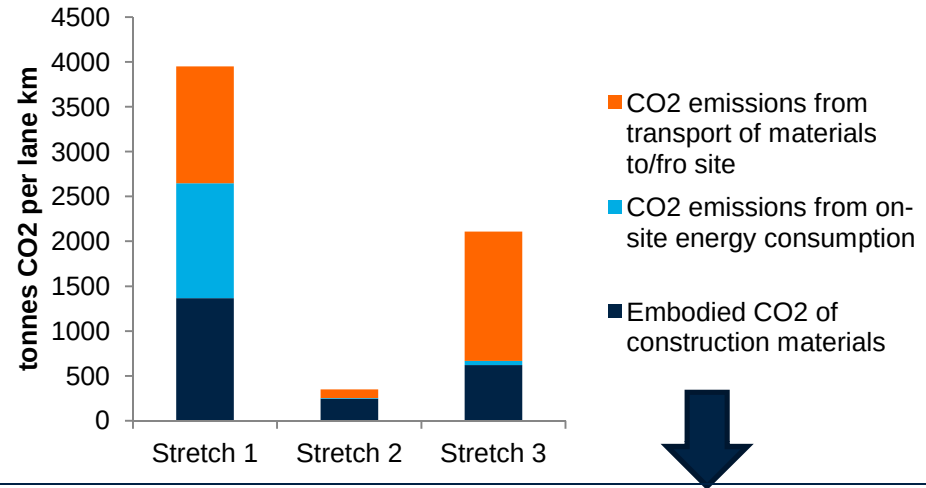
- ❖ Preparing Inventory of locally available materials and encouraging their use.
- ❖ Industrial and building waste.
- ❖ New materials accredited by IRC.
- ❖ Environment friendly new technologies/ materials, e.g. Cold Mix Technology, Jute/ Coir Geo-textiles, Waste Plastic, fly ash etc.

Construction Phase Emissions

Stretch-wise CO2 emission during construction phase

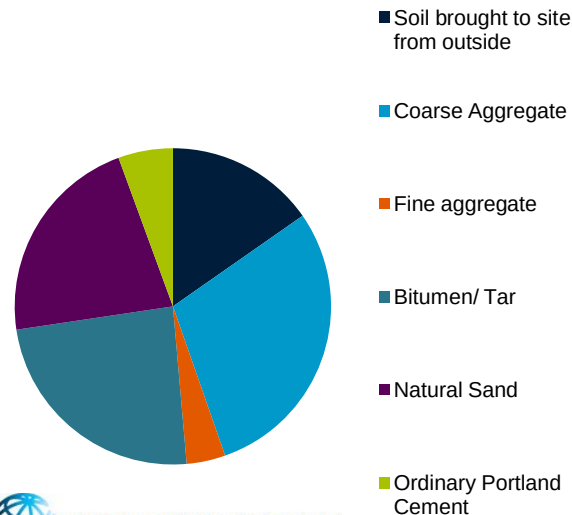


CO2 emission on account of construction activities

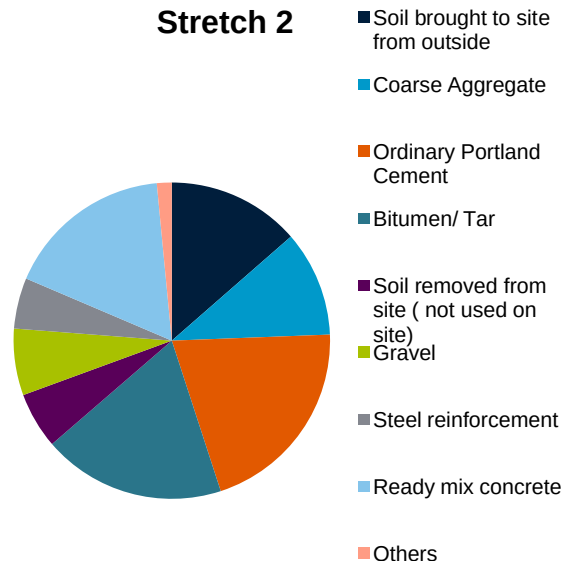


CO2 emissions on account of construction materials/embodyed (% share)

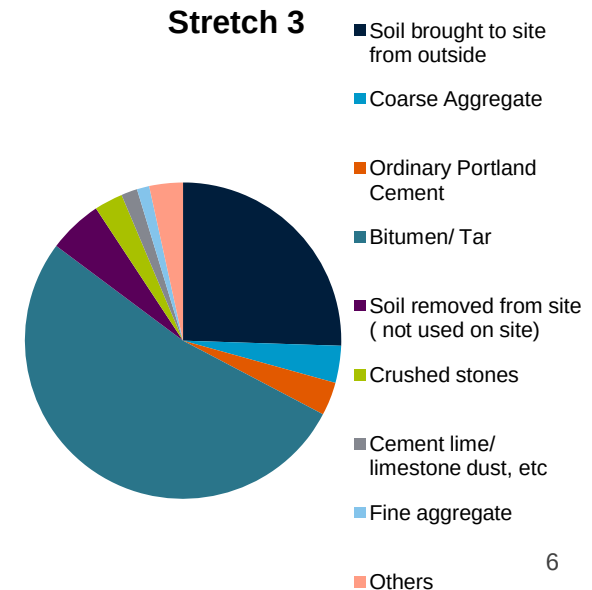
Stretch 1



Stretch 2

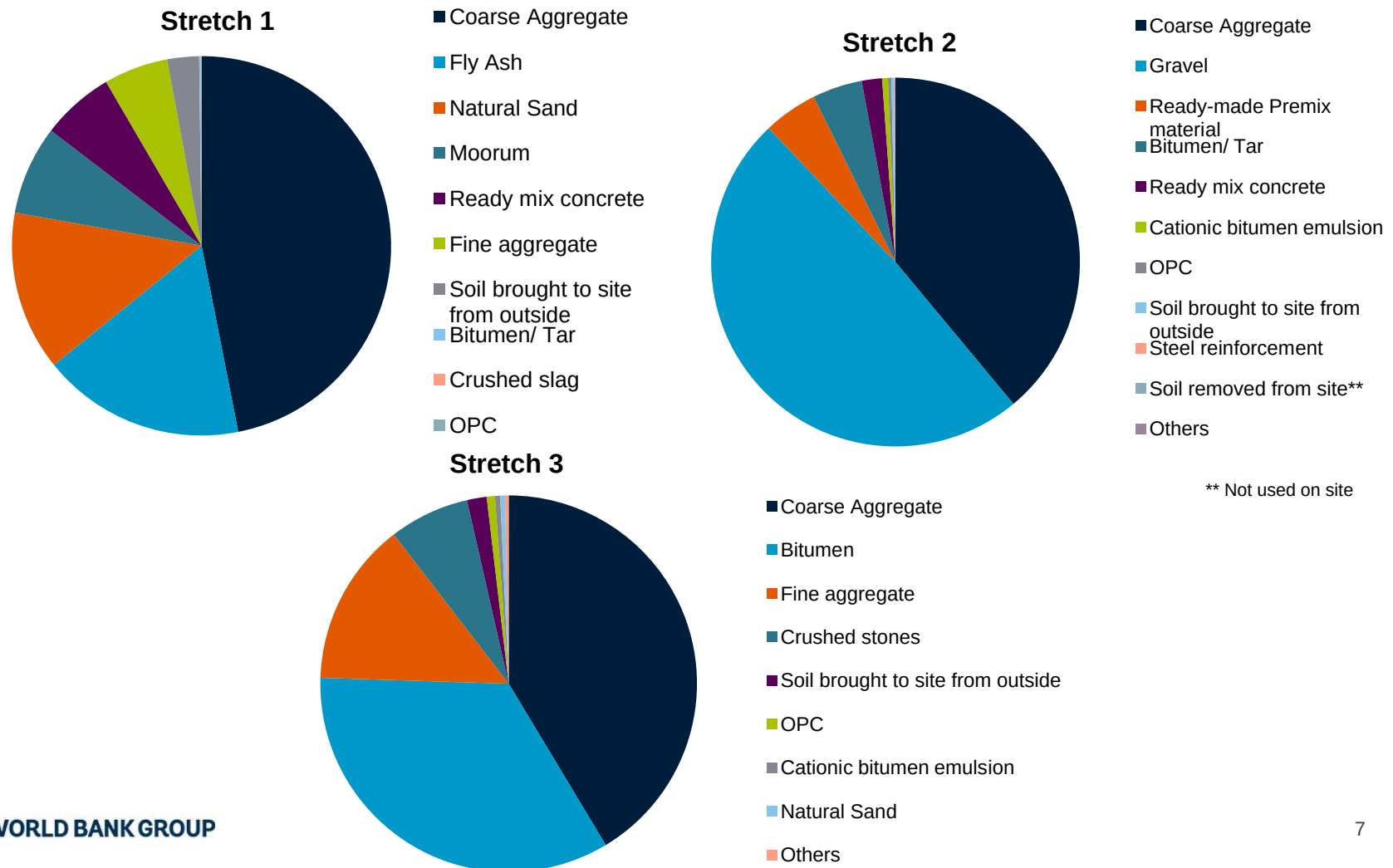


Stretch 3



Construction Phase Emissions

CO2 emissions occurring on account of transportation of materials, fuels, etc. to and from construction site – share of different construction materials



Mainstreaming of New Technologies/Materials

Technology with IRC Specifications:

- ❖ Lime stabilization
- ❖ Cement stabilization
- ❖ Mechanical stabilization
- ❖ Use of Fly Ash/Pond Ash
- ❖ Lime, fly ash stabilized Bases
- ❖ Use of fly ash in cement for concrete structures
- ❖ Roller Compacted Concrete Pavements
- ❖ Cold Mix
- ❖ Waste Plastic

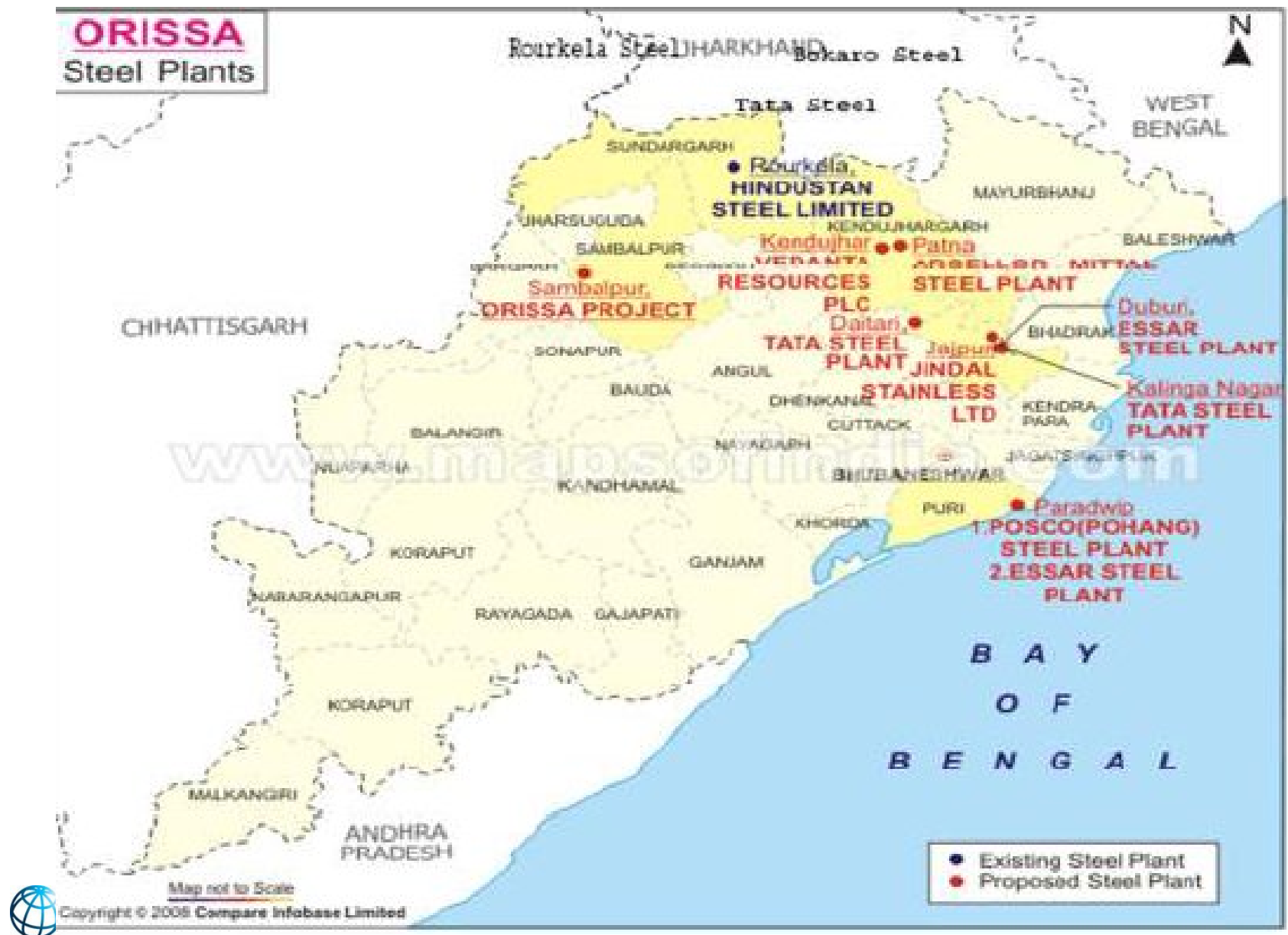
Technology with Non-IRC Specifications:

- ❖ Locally available/Marginal materials, Brick aggregate, etc.
- ❖ Blast furnace Slag/Steel Slag/Copper Slag
- ❖ Jute/Coir Geo-textiles
- ❖ Rice husk
- ❖ Quarry Waste Materials
- ❖ Bio Engineering Measures
- ❖ Slope Stabilization, Bamboo Piling etc.





Steel Plant Eastern India



Use of iron slag



Road constructed using steel slag



Cold mix with concrete mixer



Cold mix plant at Pug Mill 150 TPH plant



Cold mix road



Workers wearing slippers
instead of boots and
hessian

Coir geo-textile use in pavement



Use of plastic waste in pre-mix bituminous carpet



Physical progress so far...

2014-15:

❖ 1,041.72 km

(Waste Plastic, Lime
Stabilization, Fly-ash, Cold
Mix)

2015-16:

❖ 2,176.34 km

(Waste Plastic, Cold Mix,
Geo-textiles, Cell Filled
Concrete)

2016-17:

❖ 5,438.81 km

(Waste Plastic, Cold
Mix, Geo-textiles, Cell
Filled Concrete)

II. Gaps in Indian Practice and SWOT Analysis

SWOT analysis...

Strengths

- Competent engineers
- Good manuals
- Long-term commitment to PMGSY roads – contractors can thus justify obtaining new and modern equipment
- Medium-term maintenance contracts
- Effective accelerated testing facilities available in India
- Need for innovative materials

Opportunities

- National policies (PMGSY)
- Creation of new SMMEs and industries
- NRRDA policies (15% innovation)
- Upgradation of the construction industry
- Job creation at low levels
- Development of by-product “champions”/experts
- Environmental and sustainability benefits

Weaknesses

- Lack of suitable materials
- Old and inappropriate construction equipment
- Lack of overloading control norms
- Ineffective implementation of maintenance contracts
- Apparent shortage of engineers knowledgeable in by-product materials

Threats

- Conservative engineers (fear of failure)
- Ineffective quality assurance implementation
- Climate change
- Monopolies take control of sources (increased prices)
- Parts of some manuals and specifications outdated

In general, the strengths and opportunities far outweigh the weaknesses and threats, and the potential for the greater use and implementation of by-product materials in

III. Monitoring and Evaluation

Design of experimental sections...

- ❖ The experimental design must be such that the trial and the standard construction are directly comparable.
- ❖ Only one variable should be different in each trial section, and the two comparative sections must be constructed identically, with only the experimental requirements being different.
- ❖ The site of the trial should be similar in terms of sub-grade, drainage and traffic.
- ❖ Construction processes on each layer must be identical, with the only differences being in the treatment necessary for the trial section or product.
- ❖ *It is often useful to design experimental sections to fail after a limited period (say 18 months or 2 years) in order to actually obtain data that can be related to the performance of the road.*

Monitoring & Monitoring period...

- ❖ Monitoring requirements depend strongly on the actual innovation being investigated, and the monitoring programme needs to be designed around this.
- ❖ *Where a layer has been constructed with some form of innovation that is required to increase its strength, monitoring should be such that this property is measured directly.*
- ❖ Experiments should be monitored on a semi-continuous basis, and assessed immediately before any maintenance or repair intervention is carried out, and at least before each change in precipitation season.
- ❖ Monitoring of trials should be extended over an adequate length of time to be able to include maintenance interventions in the overall costs - *a minimum of one life-cycle of the conventional pavement should be allowed in such experiments.*

