

→ Highway Eng - Wright  
→ Tramp. Eng. → Partho Das

30% cost of new project, 70% maintenance in developing country.

Developed → 5% new construction.

Low cost roads:

কমি. invest করা মানে না.

Low volm rural area, rural area developing country  
কমি. কমে international aid লাভ.

UKaid

TRL → UK based, road construction এর analysis

করে manual করতে UKaid.

Low cost এর জন্য manual.

Glossary of technical term:

Borrow pit → embankment করার জন্য মাটি সর করা,  
↓  
yard or জায়গা

Highest flood level বন্ধ করে, 1/2 m free board add  
করে embankment এর top level set.

Bd কে খানি জমি নাই, so costly way কে খানি হয় মাটি,

## California Bearing Ratio (CBR):

for highway purpose soil strength index

### \* Low voltm road:

LGD নামক ব্যক্তি করেছেন যেখানে 10 টি সড়িক পথের  
মধ্যে ৩, ~ ৭ Bd pioneer.

### \* Macadem:

crushed stone সঠিক compaction করে যে রকম  
সেই bitumin দিনে bituminous macadem.

### \* Slurry:

আর water দিনে waterbound macadem. H<sub>2</sub>O না  
দিনে dry macadem. Penetration macadem 3 গায়ে

## 1.1 Background:

unvealed সঠিক কাঁচা ব্যক্তি.

## 1.2 Guideline Principles:

3. local resource: Bd ৩ এর brick.

But brick (ক) environmentally compatible করা  
difficult.

Local resource & economy }  
Operation & safety } fig 1-1

### Fig 2.1: Life Cycle:

for 20 yrs:

1st is low cost but maintainance cost is high

1st is high " " , 1st 10 yrs "

2nd compare करे देखते रहे (कानोस) cost is high

अच्छे life cycle cost.

### Optimum Geometric design:

Depends on → cost  
→ terrain etc

### Fig 3.1:

Min<sup>m</sup> (न्यूनतम) साइज 5m, but LGED (8' 3" or 2.5m) maybe 2 rickshaw can pass.

LGED (8' 3") highest 20'.

Fig 3.1 is unit 2m 4 wheel vehicle.

### Table 3.1: Env. Impact factor:

अतः LGED road से industry बने, but it is not suitable for trucks.

⑦ Side drains, height, crown

### 3.9: App. use of Local Mat.

Brick দিয়ে बनान, but 30% bitumin bonding poor, so consider

processing → dust, env pollution 2<sup>nd</sup> brick

### Fig 4.1: Ident. & Planning Actions:

feasibility study किये शक → cost benefit

feasibility study (शक कर: 4.5: Key Outcomes.

### Quality control (construction material):

5.2: Typical Longitudinal

CBR field & on field एक soil का lab →  
CBR low होने के लिए soil, उसका ground development  
& एक शक on pavement type (maybe) change कर  
शक.

### 5.3.4: Spot Improvements:

बुराई improve ना करे only एक spot ~  
एक एक spot का लंबे along length test कर  
test ना करे बुरा improve करने economy  
hampered शक.

### 5.3 summary structural design:

→ DEP instead of CBR  
→ traffic  
→ material property  
→ variability  
↳ primary data (जो बुरा better)

processing → dust, env pollution - 2<sup>nd</sup> brick mfg.

### Fig 4.1: Ident. & Planning Actions:

feasibility study করতে হবে → cost benefit

feasibility study (সহক ভাব: 4.5: Key Outcomes.

### Quality control (construction material):

5.2: Typical Longitudinal

CBR field এ or field থেকে soil লেব →  
CBR low হলে সর্বম soil. ওহা ground development  
এ মতে হবে or pavement type (maybe) change করতে  
হবে.

### 5.3.4: Spot Improvements:

বুঝতে improve না করে only একটি spot ~.  
এই একটি spot জাততে along length test করে  
test না করে বুন improve করলে economy  
hampered হবে.

### 5.3 summary structural design:

- Dynamic cone penetration → DEP instead of CBR
  - traffic
  - material property
  - variability
- ↳ primary data (সহক বুন better)

03.9.16  
Saturday

## Lec-2

### Low Cost Roads:

- Marketing opp.

River network dry হতে পারে, so river এর sub road করতে,

Natural gravel কম, brick অল্প. বেশি পাওয়া যায়.

Range: soil stabilized to bituminous surface

Abundant bolder পাওয়া গেলে stone pavement.

Gravel maintenance ↑ করে, cause loose থাকে,

### Disadvantage:

পুনঃ regaveling করতে খরচ ↑

### Option?

Earth use maximize করতে হবে, পুনঃ spot improvement.

But এখন্য throughout alignment investigate করতে হবে, এখন্য  
খরচ হবে.

Gravel bd এ পাওয়া যায় না, nonrenewable, so env degradation  
হবে, So জোর use করতে হবে - Judicious use of gravel

Labour based method maybe costly, cause labour ঝাঁক দিলে,  
manager ঝাঁক দিলে, So জোর feasible না.

Full scale automation হতে পারে.



## ☐ Low Volm Road Pavement & Surfacing Option:

Surface কে ২ অঙ্গ বলা যায়

1) Bituminous seal                      ② Block Surfacing

\* Chip seal এর চেয়ে

slurry → cap seal

\* Otta seal like chip seal, just কিছু fines আরে থাকে,

## ☐ Base/sub base এর option:

- plastic material না থাকলে      no H<sub>2</sub>O needed - indirect  
dry bound Macadam

- Natural gravel and graded crushed stone

↓  
smooth rounded surface  
(shingles)

↓  
Angular, greater friction  
(এটার মান ↑)

- Lime stabilization: soil এর আরে certain %, lime (কিভাবে,

- cement " : " " " " " cement "

- Bitumin emulsion ও দ্রব্য মিশে পারে

- granular material, vibration use করে compaction: Mechanical.

## • concrete Option:

pavement span বেশি হলে reinforcement লাগে,

## • Additional:

Wheel track paving → to save money.

কুর্ট্র উত্তরে দাবা মটোসে গাড়ি মাঝে,

## General Construction Note:

↑ crossfall, जो फिल drainage facilitated, but prob  
इस high speed traffic →, but L.C road → high speed  
ना.

## Cement Stabilization:

③ Roller 2 modes → operated: with & without vibration

## Lime Stabilization:

Fanidpur, Gopalganj → plastic clay soil, अर्थात ~ cement  
stabilization

③ Field CBR costly. Field → field density test, Lab → CBR test

## Engineered Natural Surface:

③ Natural Gravel Road: construction vehicle, forestry vehicle  
उस suitable

## Rolled-in stone chipping:

Motor bike → उस suitable

## Hand Packed Stone:

Dust problem, shacking, not suitable for bike

उस (माला) काटे (काम) पर

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Table-1 : Schedule of Alternative Road surface Improvements:

Popular for us clay brick surface

- \*) Dressing surface
- \*) Slurry seal
- \*) Premix Macadem
- \*) Water bound Macadem : Gradation choice করে water mix করে compaction.
- \*) Dry Bound Macadem: Plastic content না থাকলে graded agg দিয়ে vibrator দিয়ে compaction.
- \*) Slurry bound: class of penetration macadem. Agg size ছোট & bitumin বা আরও sand mix করা হয়।
- \*) Penetration Macadem  
আরও stone ছিট্রা, তার উপর liquid bitumin.

Low Vol<sup>m</sup> Road Pavement and Surfacing Option:

Block Surfacing: Mortar না হলে আরও sand দিয়ে হবে।

General construction note:

Cement stabilization:

usually (एक) (एक) sheep steel wheel roller.

→ static roller  
→ vibratory

Sheep foot roller का

normal is Pneumatic, sandy को (एक) (एक) 1-2 (एक) vibratory  
cause sand compact (एक) vibration (एक).

### 12) Cobble stone pavement:

ecubical shape stone used

### 13) Telford Paving:

### 14) Bituminous sealing:

1st layer (एक) (एक) & 2nd layer (एक) (एक) stones used.

### 15) Bituminous Emulsion sand seal:

Bituminous particle oil (एक) submerged → emulsion,  
heating (एक) (एक), oil (एक) (एक) bitumin & sand mix  
रक. (एक) (एक) no heating.

### 16) Bitumin Emulsion slurry seal:

### 17) Hot Cape seal:

Riding quality of surface (एक) (एक) used. Noise (एक) (एक)  
while driving.



17) Armored Natural Gravel:

18) Lime Stabilization:

plastic soil is a good option.

19) Cement Stabilization:

20) Bitumin Emulsion stabilization:

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1.10.16  
Saturday

## Lec-4

### Mechanical modification

#### Concrete options:

- geo cell paving
- Non reinforced concrete : larger scale of geo cell paving certain length  $\approx$  कड़ा मात्र।
- Miscellaneous

#### Gravel Pavement life cycle graph

Single surface <sup>dressing</sup> grading, double surface dressing :  
diff with penetration macadam is एकरा एकर bitumin  
को, p.m  $\hookrightarrow$  एकर egg then bitumen.

#### Seal options:

Table 1: Bitumin surfacing for low vol<sup>m</sup> roads

3.12.16  
Saturday

pumping mechanism → from book  
maintenance of concrete pavement

do/

2 ds/m

200 mm h<sub>2</sub>O/cm

=  $\frac{20}{10}$  s/m

=  $2 \times 10^3$  h/cm

200  $\mu$ s/cm =  $200 \times 10^{-6}$  s/cm

=  $2 \times 10^9$   $\mu$ h/cm

$200 \times 10^{-3}$  mil's/cm = 0.02 ds/m

$2 \times 10^{-4}$  ds/cm

3.12.16  
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pumping mechanism → from book  
maintenance of concrete pavement

ds/

200 μmhos/cm

200 μs/cm = 200 × 10<sup>-6</sup> s/cm

200 × 10<sup>-3</sup> mili's/cm = 0.02 ds/m

2 × 10<sup>-4</sup> ds/cm

2 ds/m

=  $\frac{2}{10}$  s/m

= 2 × 10<sup>-3</sup> s/cm

= 2 × 10<sup>-9</sup> μoh/cm