30/8/2016
Tuesday

Lec-1

Textbook → given in sheet

Introduction | university
Department
Course → Highway material & Mix design

Rationale of the Course → CT তে আসবে, exam এ | Question in CT 1

Materials for Road construction

① University তে physics, chemistry এর মত আসবে, But to create a group of engineers Earth Pakistan Engineering University.

Q. What is the nationale of this subject? এখন Highway material & Mix design → আগের sir এর part এর

CT তে 4টা question হবে,

Rationale - যৌক্তিকতা, (Civil Engineers plan, design, construct & maintain civil Engineering structure. এর course টা তে Eng. possible না,

of this works materials knowledge is important.

Anything manmade on the earth surface or underneath the earth surface is civil engineering structure.) + next page

Anything we see on or below earth CE structure.
building এর ভেতরে কি হচ্ছে তাটা না।

(Without material knowledge Civil Engineers cannot find the dimensions of the civil engineering structure.)

like concrete এর জন্য f_c', f_y জানতে হবে, না জানলে dimension of building জানা যাবে না।

* The question can come in other forms. Sheet এ দেয়া আছে, দেখে নিতে হবে।

6/9/16
Tuesday

Lec - 2

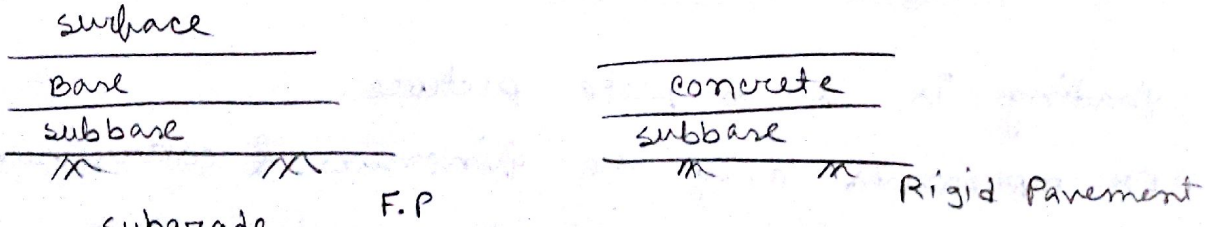
Materials for civil and highway constructions
" for construction in developing countries
Definition of terms related to Tender Document
} Sheet 4 CT ques

Aggregate:

Defn.
Properties
Tests
Specification

(*) Highway engineering civil eng. ছাড়াও হতে পারে, so that can be a different subject.
যেমন: traffic characteristics, যেগুলো দরকার statistics.

(*) Aggregate কেমন volm occupy করে। 80 to 90%. এই aggregates



↳ মাটির নিচে top 300mm এর subgrade, এটার bearing capacity এর উপর depend করে pavement বানান হয়।

subgrade is compacted earth surface on which pavement is constructed

20/9/2016
Tuesday

Lecture 3

Blending of Aggs | what is it? sheet 4

Test of Aggs | strength tests — | - ASTM
- BS
- others

specification of Aggs

SAND

Blending → mixing of two or more agg.

why? → we have to mix in order to get a specified gradation.

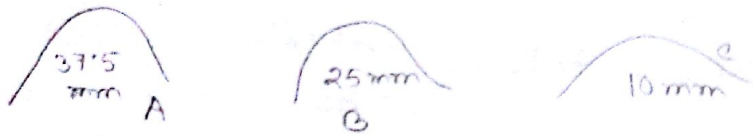
Q. Where there is an agg construction there is an agg grading → justify.

Ques → 1. what type → brick, stone
2. what stone → crushed or uncrushed
3. Max^m size → 25 mm
4. What are the proportions of other sizes
— the gradation (in table or curve form)

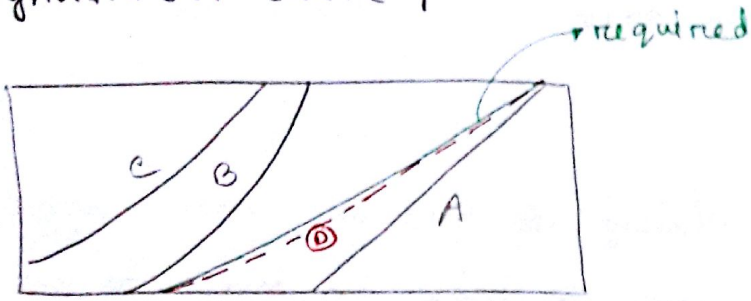
am

The 4th ques, is in the tender document.

6. Market survey, কি কি available



7. then gradation curve plot



তাই কি proportion এ মিশালে required আসবে সেটা বের করতে হবে, D পাওয়া যায় কাছাকাছি,

The proportion of diff agg to get a specified gradation is called **job mix formula.**

একদম same হবে না, কাছাকাছি, Tolerance level থাকতে হবে যে centerline থেকে কতটুকু deviation possible.

Q. How blending is done?

3 methods → 1) eqn method

2) Trial & error method

3) Graphical method

1) eqn method:

A, B, C এর proportion x, y, z

Engineering material's এর aziz এর বই এ x, y, z দিয়ে eqn method এ দেয়া আছে,

2) Trial & Error Method:

Chapter 19 → selection of agg → job mix formula table 19·4, 19·5 example

3) Graphical method:

A, B, C এর ordinate থেকে percentage বের করে,

Testing of Aggregate:

1) Strength test:

Strength → hardness
→ toughness

* Agg not to be crushed under wheel loads → এরা hard হলে চাপে গুড়া হবে না, hard হলেও বেশিদিন নাও টিকতে পারে

* To withstand load under severe condition and adverse condition → এটা toughness. So ~~board~~ repetative load দেয়ার পর যে অবস্থা হয় সেটা যদি এ নিতে পারে then এটা toughness.

1) eqn method:

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Chapter 19 → selection of agg → job mix formula

table 19·4, 19·5 example

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* To withstand load under severe condition and adverse condition → এটা toughness. So ~~hard~~ repetative load নেয়ার পর যে অবস্থা হয় সেটা যদি এ নিতে পারে then এটা toughness.

We want both hardness & toughness for agg.

AAV → agg. abrestion value test

Absorption test:

3টা value of SSD test এটা থেকে 4টা result
e.g, - - - -

Durability:

Ability to retain original strength characteristics under extreme weathering agents.

Weathering agents → rain, temperature, snow.

1) Sodium soln এ ডুবাব, then cycles এ ডুবাব, then agg ভেঙে যাবে, seiving করব & কতটা pass করল or ভাঙ্গল তাতে % এ লেখব.

2) wet & dry → ভিজাব একবার then শুকাব এটার cycle.

Other test of agg:

Sheet 8

Q. CT → what are typical values for strength for Brick Agg.

Sheet 5, sheet 6 → cement concrete

Sheet 11 → table 13 → for Asphaltic concrete

এটার test name exam এ আসে

27/9/2016
Tuesday

Lec-4

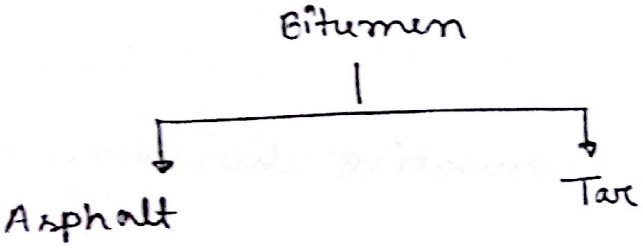
Bitumin/Asphalt — sheet .12

What is it?

Why is required?

How is produced?

What are the properties, tests and specifications?



Sheet-14 : Intro of bitumin

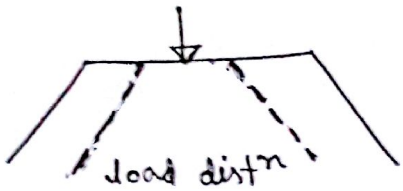
cement ব্যবহার 1st 1913 এ bombay এ
Americans 1904 এ start করে
ভারতে 1895 " " } cement

What is it?

chemistry 1) Aliphatic chain
2) Aeromatic unsaturated ring
3) Aeromatic saturated ring (compound of carbon & hydrogen)

Exact molecular formula is not generated.

Rigid Pavement → concrete slab with reinforcement

Flexible " → 

* In flexible pavement bitumin is the binder material of top surface. Bitumin will give the flexibility nature.

Why is it required?

How is produced?

= Tar is by product of destructive distilation of coal and wood.

= Destructive distilation দ্বারা to produce gas.

= London, paris ত 1960 এর আগে (maybe) towngas produce করত যা (CH_4) it's by product was tar by destructive distilation.

* Asphalt & Tar এর property কাছাকাছি, Adherion ভাল In some case tar better as of tar. But prob হল tar temperature এ sensitive, সহজে গলে যায়, ভাঙ্গুর হয়, তাই not desired. in engineering.

এজন্য tar is obsolete.

Asphalt

Natural
1) Rock Asphalt
2) Lake "
3) Gilsonite → one kind of rock asphalt

Artificial
from refining crude petroleum
(99% Asphalt in world)

(*) Animal deposits এর চর্বি মাটিতে চাপা পড়ে crude petroleum হয়।

(*) Chapter 15 → পুরোটা পড়তে হবে।

4.10.16
Tuesday

Lec-5

Bitumen – Types
Grading
Properties
Tests
Specifications

Straight run asphalt from refinary
- Gasoline
- Kerosene
- Diesel
- lubricating oil

Sheet 10 flow chart of refinary

solid
semisolid
liquid
} এগুলো consistency test, to know existing condition

Asphalt may have oil fraction, যদি extract করলে semi solid, আরও extract করলে solid.

~~suppose oil seed থেকে~~ তেলটা stop করব that depends on economic aspect.

We get semi solid or liquid

Straightrun asphalt used in road construction.

* Air Rectification করলে → Air Blown Asphalt.
এটা crack sealing এর জন্য used.

* semi-solid + Gasoline করলে rapid curing cut black asphalt
" + Kerosise " medium " " "
" + Diesel slow curing but black asphat

এর ভিসকোসিটি MC 250, 800 এমন, এটা viscocity number. কতটা gasoline/Kerosine মিশালাম এটার উপর dependent.

We want liquid asphalt, so that aggregate কে coat করে।
To make this add oils.

* Cut black হল liquid asphalt

* In most cases semisolid থাকে।
* straight run asphalt + water ⇒ Emulsified Asphat
cataionic / Anionic

Sheet 12, Q. What are the desirable properties?

⊛ Properties of bitumen – 3 type properties

1) sheet 12 – common properties
2) sheet 10 – desirable ,,
3) 15.3 → what are the properties of agg. } 2টো diff
এটা sheet এ অন্য name এ আছে

কোনটা চাওয়া হল বুঝতে হবে।

common & general properties same.

Grading:

1) Penitration Grade – from penitration test
2) Viscosity ,, –
3) Performance ,, –

15.17 → classification of bituminous materials.
3টা table দেয়া আছে। pg - 428, যেকোন একটা exam এ আসবে।

Tests:

Table 15.6 → pg 422, exam এ আসে, ct তেও আসে।

viscocity opposite to fluidity.

Temp suseptibility sheet - 14 এ আছে।

Q. what is penitration index of bitumen – sheet 14 এর 2 paragraphs

Specification:

Modified ~~bureau~~ binders

ভারত এর general classification

SBS modified asphalt styrene bitudiene styrene } modified (Block)

* Sheet 11 – Table 8.4
* Sheet 10 – Modified binders (for exam) ?

Lec - 6

18.10.16
Tuesday

semisolid penitration grade :- commercial name asphalt cement

In Bd, we have portland cement (PC), but we have PCC → portland composite cement.

Hot mix, hot layed → hot বলা হয় semisolid কে liquid করতে.

Emulsifier :

1) Sodium Stearate
2) Cetyl triethyle amonium

Quest :
where is used?
Roof ও ইহা used, so +ve charge থাকে, so anionic used
sand stone রাস্তায় -ve charge holder, বিভিন্ন অবস্থায় উভয় agg - ve ions, so cationic used.

(*) Exam : Tests for emulsified Asphalt
Seive test, - - - - (From Book)

Specification for Emulsified Asphalt : sheet 11

Table 8·5 → Pg 820.

2. Exam → Appropriate grade for Bitumen for Bd

25.10.16
Tuesday

Lec-7

Sheet-13 Bituminous Mixes:

What is it ?

Why is required?

Where is placed?
What are the types
How is done?

What are the properties, design & spec?

sheet 15 → summary (8-11)

sheet 16 →

Chapter 19 → Every line must be read

Concrete mix → cement concrete → mix design → BS Method
→ ACI

Asphaltic/bituminous concrete

ch. 19 → 2 mix design method → Marshall method
→ Hveem "

Coarse aggregate + F.A + Mineral filler

CA → (+)4.75 mm
FA → (−)4.75 mm
MF → −0.075 mm

→ for cement concrete

} Asphaltic concrete

this is objectionable for cement concrete, but is

a must for asphaltic concrete.

cement + water = makes a gel H-C-S gel (it hardens the concrete)
(for cement concrete)

↓

H_2, calcium & silicate gel

For asphaltic concrete + Asphalt/Bitumen in liquid consistency.

In CC we add diff materials to improve quality they are called admixtures. Like retardars, plastisizer.

In asphaltic concrete adv. এর জন্য আলাদা mat. use করা হয়।

2. Why is required?

Because we want to construct flexible pavement. Flexible pavement এর criteria হল each layer has to be flexible. To acheive this base & surface coarse is made of bitumen as bitumen is a visco elastic material, it can take the load and after removal the stress is released. cement concrete & agg. have rigidity, so add some thing that will make the mass flexible.

3. It is used in the upper layers. (where is placed?)

BDS-208-2002 → classification of brick

4. What are the types?

15/11/2016

Lecture - 8

Design of High type Bituminous Mixes

Characteristics

Fundamental Properties

Materials

Requirements

STEPS for Mix design

1. 2. 3.

Step 3 : optimum Asphalt content method, General steps

(*) Sheet 15, 16, Book chapter-19,

High-Type → ভালো রাস্তাকে

High cost, High specification & High volm of traffic এর জন্য design.

Intermediate Type:

Macadem এর ধরন -

রাস্তাতে যেকোন bituminous macadem used

Sheet Asphalt, sand asphalt

Add to sheet of sir → Mastic Asphalt

Jamuna bridge ও after repair work stone mastic asphalt (SMA).

Stone filled sheet asphalt বলে american রা।

Q. What are the characteristics of High type bituminous mixes? (Exam)

বই এ প্রশ্নের italics এ লেখা, 7 points.

Design of High type paving Mixtures:

Fundamental Properties:

1) stability → can take load without being crushed
2) Durability → টেকসই হবে
3) Skid Resistance
4) Economic → Fundamental for all engineering project Economic mixes with required properties is known by the civil engineers.

Materials:

~~b~~ c তে ও তে fines যে coarse agg আছে থাকে, a তে voids. So b optimum voids are filled with fines.

Requirements:

Design = Aggregate blend + এর সাথে কতটুকু % bitumin দিতে হবে

এটা material design. (Optimum binder content).

Design ২ রকম — 1) Agg. blend → C.A, F.A & filler
2) ঐ ,, এর জন্য কত % bitumen → এটা lab এ করি

Steps for mix design:

1. Sufficient supply আছে নাকি think করতে হবে, source আছে কিনা করতে হবে।
2. Job mix formula
3. OBC or design binder content (OBC)

Job mix formula → Agg blend + bitumen addition

Step 2 & 3 → 19·14 → স্লাইডের দেখা

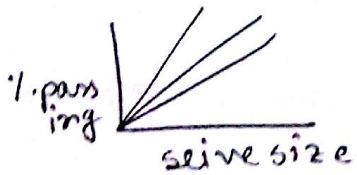
Coordination of mix design testing:

Step 1: Fraction of agg that is objectionable for cement concrete that is beneficial & must for asphaltic concrete → এরই mineral filler.

Step 2:

$(D/d)^n$ $n = 0.5$ হলে parabollic curve হয়। } don't need it

$n = 0.45$ হলে



হলে st. line

Typical Agg Grading:

বই ও, table numbers may be changed

Selection & combination of Agg:

Trial & error method for Job mix formula.

Table 19.4 → 3 agg given
19.5 এ এদের combine করতে, এটা final trial.

Step 3: Optimum Asphalt Content:

যে পরিমাণ bitumen agg blend এ add করলে specification meet করে।

29.11.16
Tuesday

Lec-10

Hveem method of mix design

General

Outline of method

Approximate Asphalt content by CKE [centrifuge kerosene Equivalent]

Preparation of Test Specimen

Q. Compare marshall and Hveem method of mix design, regarding (anything).

- Design criteria
- optimum Asphalt content
- tests
- general বাদে 3য় topic

→ Marshall only applicable for hot mix hot laid.
But Hveem for both cold mix cold laid এ " " " .

→ Hveem এ cutback asphalt used, Marshall এ no cut back asphalt.

Book: 19-1-10 (outline of method)

Step 0 হতে step 3 in marshall.
Major difference হচ্ছে, optimum asphalt content measured in Marshall.
But in Hveem approximate asphalt content is measured.

Optimum Asphalt content,

4
4.5
5
5.5
6

} From experience we found যে naturally 5 থাকে, so এর থেকে ২টা বেশি ২টা কম

But Mr. Hueem বললেন we don't have experience. from material property we find approximate asphalt content (by CKE). এর থেকে ৭ এবং কম bituminous material নিয়ে specimens বানানো হয়.

So marshall এটা assume করে Hueem এটা বের করার জন্য rigorous experiment করে।

Step D: Approximate Asphalt content Determination:

19-8:

Step 1: 1st determine surface area.

Step 2: 100gm dry fine agg (passing #4 seive). এটাকে Kerosine এ saturate করলাম, so wt. বাড়বে (হল 102gm), Then এটাকে centrifugal force apply করতে হবে, 2 min ঘুরাব, then wt নিব wt হল 101gm.

∴ Kerosine retained = 1%, এটাই CKE.

⊛ Always percentage is on the basis of dry wt.

Book ও agg এর S.g 2·65.

correction লাগবে, $\frac{\text{আমাদের agg এর S.g}}{2{\cdot}65} \times \text{CKE} = \text{corrected CKE}$

Step 3:

Book ও ., Determine surface capacity. এটাতেও correction লাগবে same as in step 2.

correction for K_f বের করার পর সূত্র দিয়ে k_m বের করতে হবে,

Step 7: RC, MC, SC-250 হলে direct graph থেকে oil% পাব,

Step 8: A & B connected, C তে interrect. D & C connected & extendend, it interrects E.

06.12.16
Tuesday

Lecture - 11

Hveem method of mix design

- preparation of test specimen
- Testing
- Analysis
- Determination of OAC

- Marshall এ stability, আর এখানে stabilometer test.
- At least 1 among 4 এ bleeding হবে, আগে bitumen বের হয়ে আসবে।

(*) 4টা থেকে design asphalt content বের হল, Then এটা দিয়ে 2টা করায় swell test.

ACI বলে min 2 specimen for any test.

diff with Marshall

(*) Marshall এ কোনোরূপ আগে আসে compacting, But এখানে curing করতে হয়।

Marshall এ compaction by drop hammer method.

But এখানে Mechanical kneading compaction.

Lec-12

20.12.16

Sheet #15

Superpave Mix Design

Salient features

Selection of Asphalt binder Pg 553

Selection of Agg. Pg 556 (Table 10-11)

Selection of Design Agg. structure - Pg 55[illegible]
(Table + curve দেয়া আছে)

Design Asphalt binder — Pg 559

Evaluation of moisture sensitivity Pg 559

INTRO... ...RING SATURATIO...

Jakaria Sir (Lec-12)

Sheet #15

Superpave Mix Design
Salient features
Selection of Asphalt binder P-553
" " Agg P-556
" " Design Agg structure P-558
Design Asphalt Binder, P-559
Evaluation of Moisture Sensibility, P-559

Superpave
Superior
Performing
Pavement
} design system.
superpave নামকরণ-
(তাৎপর্য বিশ্লেষণ)

এর পূর্বে ধারণা-
- classification of Bituminous material.
all types
- grades of bitumen ⇒ Straight run asphalt (Asphalt cement) → P-428
asphalt - semisolid. → P-571.

~~Performance grade~~.

Penetration grade

Viscosity grade | 1.
2.

Performance grade => chp-19. P-553

this is required for superpave mix Design.

Table 19.9, 19.10

=> Test parameters

=> Equipment for superpave binder ~~mix~~ test.

Table-19.11 => consensus properties of agg. for superpave mix design.

selection of Design Agg structure

=> table & curve আছে।

Evaluation of moisture sensitivity

=> Emp for BD

voids ছাড়া other parameter

Va, VFA, VMA.

→ নতুন কোনো sheet দিয়ে হবে ও নাই —

– 12টা mix design method.

~~Stagent~~

Stone Matrix Asphalt (SMA)

SMA : stone Mastic Asphalt
(British/India)

Ultra thin bonded ~~...~~ wearing course টা—
→ যদি use করা, কোনো structural layer না, treatment.

যদি stone এ Fe থাকলে জারিত হবে— যেহেতু pore দিয়ে জল ঢুকে ক্ষয় হয়ে যায়, পানি লেগে pot hole করবে।

for treatment

(for BT)

⇒

Imp: Construction of road embankment is the ~~...~~ 1st work to do before road construction

Chp-15 মৃত্তিকা Agg (সমাজ) structure
soil part-এ xm এ আলোচনা but imp.

FB ID
Zak Shugandhi