UNIT 4 : Contributing Crash Factors , Countermeasure Selection ,and Evaluation

2 TYPES OF QUALITY CONTROL EMPLOYED IN ROAD CONSTRUCTION.

TYPES OF QUALITY CONTROL

One of the most important tasks of the supervision during the execution of a road contract is technical quality control, i.e. control as to whether the materials and work supplied by the Contractor meet the technical requirements in the contract specifications. There are two types of quality control, which are described below:

1.CONTROL OF METHODS

Method control is usually carried out by the Consultant`s field staff whose job it is to be on the site and supervise the Contractor during the execution of the works. At the same time the field staff will perform simple measurements, such as the recording of the thickness of fill layers, the temperature of asphalt material, and the slump of cement concrete.

Method control is carried out according to the type of work. Where the work method is of considerable importance and requires constant supervision to achieve the quality, or where in some case, the quality is difficult to improve on, there should always be a field engineer on the site. Examples are the ramming of piles, the laying of asphalt, and concreting etc. Where work methods are of less importance or quality is constantly being achieved by the contractor, there may be no need for continuous surveillance.

2.CONTROL OF END-RESULTS

End-result control includes field tests e.g. control of the evenness of completed pavement layers and laboratory tests, e.g. Marshall tests on asphalt materials. Other tests are a combination of field and laboratory tests. An example of this is the compaction control of earthworks where the achieved density is determined by means of a field test, and where the IS/ AASHTO density with which the result should be compared is found by means of a laboratory test. End results control is carried out by laboratory technicians, and most of the work consists of laboratory tests.

The frequency of end-result control depends on the quality parameters that are to be checked. Parameters which can vary considerably are continuously controlled. Examples are the composition of asphalt materials and the compaction of asphalt courses. As regards regulating laboratory tests the specification usually determines the number of tests. When the works are started and in cases where difficulties as regards compliance with quality requirements are encountered, laboratory testing will normally be intensified.

Interactive Highway Safety Design Model (IHSDM):

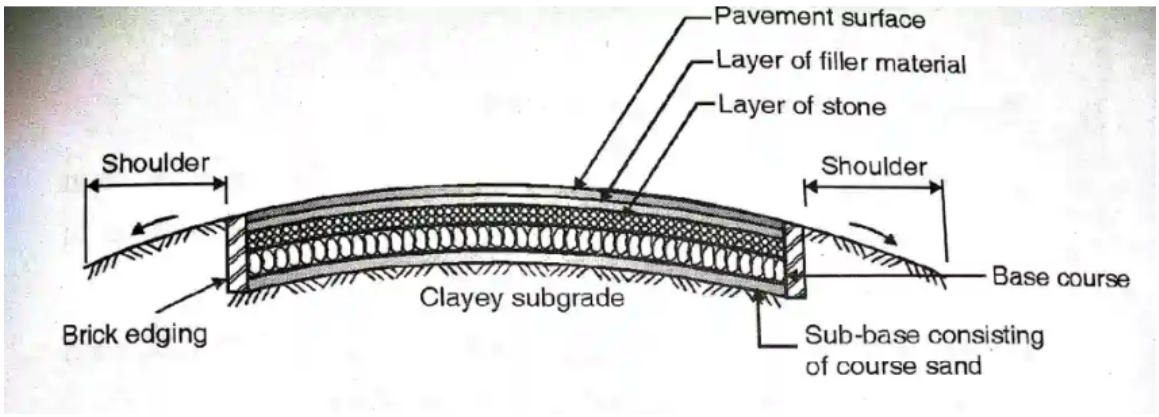
IHSDM is a suite of software analysis tools used to evaluate the safety and operational effects of geometric design decisions on highways.

IHSDM is a decision-support tool that provides estimates of a highway design's expected safety and

operational performance. Results of the IHSDM support decisionmaking in the highway design process. Intended users include highway project managers, designers, and traffic and safety reviewers in State and local highway agencies and in engineering consulting firms.

The IHSDM—which supports the Federal Highway Administration's (FHWA's) Data-Driven Safety Analysis (DDSA) initiative—includes five evaluation modules (i.e., Crash Prediction, Design Consistency, Policy Review, Traffic Analysis, and Driver/Vehicle), as well as an Economic Analyses Tool. This website provides a link to download the software, summarizes the capabilities and applications of the IHSDM evaluation modules, and provides a library of the research reports documenting their development.

Construction Procedure of WBM Road.



1) Preparation of Foundation for WBM Road :

The subgrade or base course is properly prepared for the required grade and camber of WBM road. The potholes and the depressions on the surface of the road are properly filled up and compacted.

2) Provision for Lateral Confinement :

Before laying of aggregates the shoulders having thickness as that of compacted WBM layer should be constructed. They should be constructed with proper quality of murum or earth.

The main purpose of constructing shoulders is that the road surface to be constructed retain in between them and it becomes easy for further laying of course aggregates.

3) Spreading of Course Aggregates :

The course aggregates are uniformly spread on the prepared base after the construction of the shoulders. Total number of layers and thickness of WBM road depends upon the details of design pavement.

In general for ordinary roads, single layer of compacted thickness 75 mm may be sufficient. For special roads, 2 layers of 150 mm each compacted thickness may be provided.

If the course aggregate is used of number 1 grade as shown in above course aggregate grading table then it is compacted to thickness of 100 mm.

4) Rolling Operation :

Rolling operation is carried out for compacting the course aggregates. Generally it is done with the help of 3- wheeled power rollers weighing 6-10 tonnes or with the help of vibratory rollers.

Skilled operators should be used for driving the rollers as the fault rolling operations causes formation of corrugations, unequal finish of road surface, wearing of road in few months of construction.

5) Application of Screenings :

After the rolling operation is properly finished screenings is applied to properly fill the voids remained after the compaction of aggregates. The screening may be applied in 3 or more layers as per the site conditions.

After uniformly spreading of screening compaction is carried out with the help of dry rollers for each layer of screenings. After compaction brooming of the each layer should be properly done to remove the uncompacted screening material.

6) Sprinkling of Water and Grouting :

After the application of screening the road surface is properly sprinkled with plenty of water. After the water is sprinkled brooming is done to sweep the wet screening properly into the voids.

Rolling operation is further carried out for proper compaction. If the voids are still visible then additional screenings can also be applied and properly compacted.

7) Application of Binding Material :

Same procedure is used for the application of binding material as that of screenings. Here after each layer water is sprinkled and rolling operation is carried out.

At the time of rolling operation the wheels of the roller should be constantly watered so as to washout the binding material that gets stuck to the wheels of the rollers.

8) Setting and Drying of Surface :

After the final rolling operation the road is allowed to cure or set over-night. The next day if the depressions or voids are visible then again sufficient amount of screenings or binding materials can be used and compaction is done.

9) Preparation of Shoulders :

At the time of Curing of road, shoulders are constructed alongside by filling earth to specified cross slope. They are properly compacted.

10) Open for Traffic :

After proper drying and without any depressions, the road is then made upon for traffic. For few days the traffic should be well distributed over full width of road by placing obstacles longitudinally in the form of drums, barricade etc.

Maintenance of WBM Road :

Whenever the potholes and ruts occur on the road by the period of time, they should be be filled with adequate materials and proper compacting should be done.

The corrugations occured on the roads should be removed by means of dragging. If not could make the condition worse.

Broken materials of the roads should be properly restored by fresh materials.

The surface of the road should be renewed in 2-5 years or based according to the traffic volume.

The loose aggregates starts coming on the top of the surface of the road, they should be removed and lavelled surface should be added by fresh binding material and it should be properly watered and compacted.

Advantages of WBM Road :

The construction cost of WBM road is comparatively low.

In the construction of WBM road no skilled labours are required.

They are constructed from locally available materials.

If the WBM roads are maintained properly and from time to time, it can resist load of traffic of about 900 tonnes per lane per day.

Disadvantages of WBM Road :

The maintenance cost of WBM roads is high.

The overall life span of these roads is very less.

If the WBM roads are not properly maintained they can cause inconvenience and danger to traffic.

As WBM roads are permeable to rain water, it leads to softening and yielding of subsoil.

Factors affecting pavement design

Traffic and loading

Traffic is the most important factor in the pavement design. The key factors include contact pressure, wheel load, axle configuration, moving loads, load, and load repetitions.

Contact pressure:

The tyre pressure is an important factor, as it determine the contact area and the contact pressure between the wheel and the pavement surface. Even though the shape of the contact area is elliptical, for sake of simplicity in analysis, a circular area is often considered.

Wheel load:

The next important factor is the wheel load which determines the depth of the pavement required to ensure that the subgrade soil is not failed. Wheel configuration affect the stress distribution and deflection within a pavemnet. Many commercial vehicles have dual rear wheels which ensure that the contact pressure is within the limits. The normal practice is to convert dual wheel into an equivalent single wheel load so that the analysis is made simpler.

Axle configuration:

The load carrying capacity of the commercial vehicle is further enhanced by the introduction of multiple axles.

Moving loads:

The damage to the pavement is much higher if the vehicle is moving at creep speed. Many studies show that when the speed is increased from 2 km/hr to 24 km/hr, the stresses and deflection reduced by 40 per cent.

Repetition of Loads:

The influence of traffic on pavement not only depend on the magnitude of the wheel load, but also on the frequency of the load applications. Each load application causes some deformation and the total deformation is the summation of all these. Although the pavement deformation due to single axle load is very small, the cumulative effect of number of load repetition is significant. Therefore, modern design is based on total number of standard axle load (usually 80 kN single axle).

Construction Layers:

Bituminous Macadam is the pavements which are constructed in different layers such as Base course, Binder Course and Surface course. These layers provide different functionality and bituminous pavements.

• Bituminous Grade- It should be between 60-70

• Temperature- a) Mix Materials

b) Laying- Max- 165 degree and Min- 125 degree

c) Rolling- Min- 90 degree

• Levels (Tolerance)

• Field density

Surface Course

Binder Course

Base Course

Subbase Course

Compacted Subgrade

Track Coat Seal Coat PrimeCoat

Natural Subgrade

Material Used:

1.Soil

2.Stone Aggregates

3.Bituminous Materials

4.Cement- Mortar and Concrete

Road Constructors:

Road constructors are the manpower behind preparing the foundations, laying the base, to topping with concrete or asphalt. A road constructor builds the side streets and motorways we all drive on. Constructors play the vital part in the road construction process as they provide all the manpower and equipment to work with and they turn the plan into reality. Road constructors should be well experienced in the field and in order to prevent obstacles. As a result to take the corrective steps from

the beginning in a cost-effective manner.

Properties of Aggregates Used in Roads

Aggregates used in road construction should have the following properties:

a. Strength:

The aggregate to be used in road construction should be sufficiently strong to withstand crushing and several stresses due to traffic wheel load.

b. Hardness:

The aggregates used in the surface course are subjected to rubbing or abrasion. So, the aggregate should be hard enough to resist wear and tear due to the abrasive action of traffic.

c. Toughness:

Resistance to impact is termed as toughness.

Aggregates used in the pavement are also subjected to impact due to moving wheel loads and hammering action due to jumping of tires.

Hence, toughness is another desirable property of road aggregate.

d. Soundness/Durability:

The property to withstand adverse action of weather or the ability to remain strong over a long period is called durability or soundness.

Aggregates are subjected to the physical and chemical action of rain and groundwater.

Hence, aggregate should be durable to withstand weathering action.

e. Shape of aggregate

Aggregates may be of different shapes such as cubical, rounded, flaky, elongated, etc.

Flaky and Elongated aggregates have lower strength.

So, generally round and angular are preferred.

f. Adhesion with bitumen

Adhesion simply means a binding property with other materials.

So, aggregate should have proper or good binding properties with bitumen/asphalt/tar.

g. Free from foreign particles

Foreign materials like dust, chemicals, etc reduce the binding property of aggregate i.e. adhesion between aggregate and bitumen is reduced.

So, the material should be free from foreign materials.

Human Factors That Cause Accidents

A variety of human factors can cause accidents. The laws of New Hampshire require all drivers to maintain safe speeds, maintain a safe distance from any car in front of them, and obey traffic control devices to ensure the safety of other drivers and passengers. Additionally, the law prohibits drivers from operating their vehicles if they have consumed drugs or alcohol in excess of the legal limit. A failure to abide by these laws is an error of judgment that commonly causes accidents. In other cases, drivers may simply lack experience driving, or they may fail to recognize that their age or health issues hamper their ability to drive safely. Even competent drivers can become distracted at times, and failing to pay attention for even a few seconds can cause an accident.

Roadway Crash Factors

1. Exposure
2. Facility type

• Interstates and freeways

• Rural roads

• Intersections

• Pedestrian facilities

• Bicycle facilities

Vehicle Crash Factors

Crash Avoidance

Crash Survivability

Road Segment means a segment of Access Road or Spur Road having distinct characteristics from an adjacent segment as defined by the Interior Appraisal Manual. Road Segments are defined by numerical character segments.(aa)“Road Site Plan Map” means a map produced at a scale of 1:10,000, or another scale authorised by the Ministry Representative, according to the specifications in this Agreement.(bb)“Satisfactory Performance” means the completion of required works to the standards and specifications outlined in this Agreement, as determined by an inspection or review.(cc) “Site Plan” or “SP” is a plan developed in accordance with the requirements set out in the Forest and Range Practices Act and the Forest Planning and Practices Regulation. An SP consists of a document and map specifying standards applicable to the SP area. Attachments and supporting documentation to the SP may include a silvicultural treatment regime.(dd)“Site Plan Map” means a map produced at a scale of

1:10,000, or another scale authorised by the Ministry Representative, according to the specifications in this Agreement.(ee)“Site Plan Error” means any unsound scientific or technical component of a SP (e.g. inconsistency with the approved Forest Stewardship Plan (FSP) or Sustainable Forest Management Plan (SFMP), incorrect Soil Hazard Assessments, inconsistency with a required assessment recommendation, proposing a harvest scenario that is not sound) or any deficiency in SP content which is a legal requirement.(ff) “Slope Break” means a terrain feature located within the Harvest Area that could or has the potential to negatively impact harvest operations - this could include gullies or ravines that cannot be skidded/yarded across, steep slopes or rock outcrops.(gg)“Spur Road” means a single, continuous length of on-block road from PoC to PoT containing one or more Road Segments. Spur Roads are defined by numerical character spurs.(hh)“Standards Unit” or “SU” means an area within a SP having the same ecological classification, soil disturbance limits and stocking standards where the minimum size will be 1.0 hectare unless otherwise approved by the Ministry Representative.(ii) “TRIM” means Terrain Resource Information Management Program. A program supplying digital maps containing topographic, cadastral, forestry, soils, man made features, and a variety of other themes.(jj) “UBI” means Unique Block Identifier to identify a cutblock within Cengea Resources.

SAFE SYSTEM – SCIENTIFIC SAFETY PRINCIPLES AND THEIR APPLICATION

The Safe System approach marks a shift from a sole focus on crash reduction to the elimination of death and serious injury. Well-established safety principles underpin the Safe System approach as set out in Key Developments. Further principles include the following:

The combination of infrastructure safety features, vehicle safety features and travel speed(s) of crash-involved vehicles determines the impact forces that humans are subjected to in any crash. These interactions are to be managed to avoid fatal or serious injury outcomes.

Safety levels are to be the key determinant of sustainable mobility levels. Travel speeds require management to target levels below those known speed thresholds that deliver fatal or serious injury crash impact energies (based on the level of vehicle safety and mix, and the nature of protective infrastructure characteristics; See also Safe System Principles and Safe System Elements).

Safe System approaches typically aim to develop a road transport system that is better able to accommodate human error by providing a safe operating environment - despite human fallibility - and providing effective post-crash care.

A system-wide intervention strategy addressing all crash-phases and all Safe System elements is to be adopted, which addresses the safety of all road users.

Legislative and enforcement strategies that achieve widespread user compliance with road rules and laws are necessary, as are strategies which deter the entry and exit arrangements of users and vehicles to the road system.