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Introduction to Construction Materials and Testing

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Learning Outcome

At the end of this lesson, the students should be able to:

1. describe the aspect of Material Quality Control,
2. describe the principle of material testing,
3. describe the procedure of quality control in a construction project,
4. correctly identify the minimum testing required as per DPWH standard.

Definition of Terms

Construction Materials
- natural and artificial products used in constructing infrastructure

Material Testing - Is used to determine the properties of specific material

Importance of Material Testing

- ✓ Testing is an important complement of quality control in engineering works
- ✓ Material testing is not done by sight or other means without the benefit of laboratory tests.
- ✓ Without testing even in the field or in the laboratory, no one can state definitely if the quality of materials is satisfied or not, even the expert.

Importance of Material Testing

- ✓ **Project Engineers, Materials Engineers and Laboratory Technicians** who are involved in the implementation of various infrastructures needs to learn & know testing technology in construction materials to enhance and strengthen their capabilities in the implementation of Quality Assurance Program in a project.

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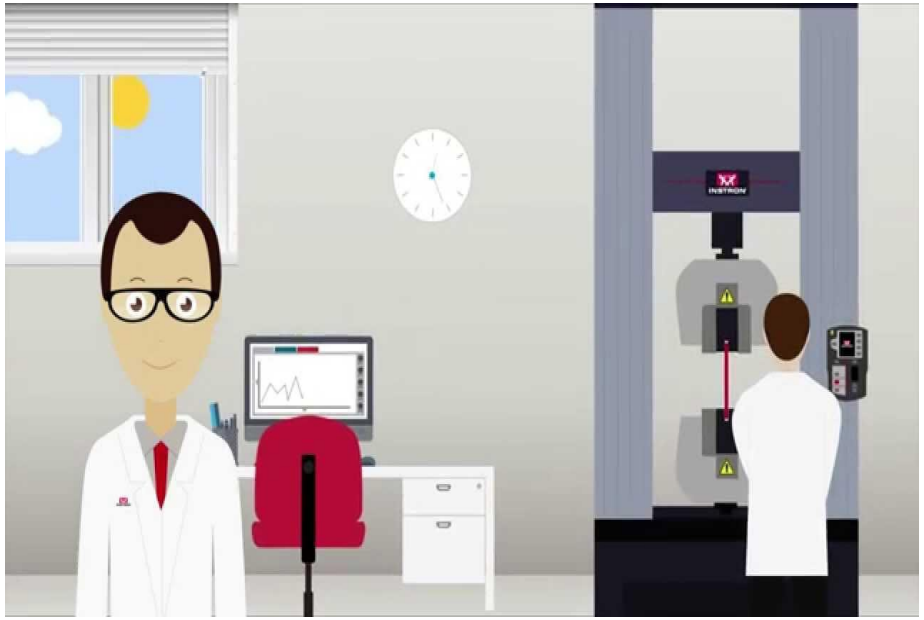
Benefits of learning Materials Testing

1. ***Recognize the basic technologies in testing of construction materials.***



- Identify and familiarize the required tests on specific construction materials
- Identify and understand the basic properties of materials
- Understand the significance of tests on the materials
- Aware of the importance of materials testing in project implementation

Benefits of learning Materials Testing

2. Perform effectively field/laboratory sampling and testing of construction materials in accordance with the standard methods/procedures.

- Familiarize in the application of the proper method of sampling of materials in the field and laboratory
- Identify and familiarize in all laboratory testing apparatus / equipment for materials sampling and testing
- Learn and familiarize standard methods and procedures of laboratory testing of various construction materials
- Learn to check the accuracy and proper maintenance of laboratory testing apparatus/equipment

Benefits of learning Materials Testing

3. Evaluate, analyze and interpret test results of construction materials for the purpose of acceptance and rejection.

- Learn proper computation and check result of tests performed
- Know the proper reporting system of test reports
- Understand the application of materials standard specifications based on the result of tests
- Learn how to analyze and evaluate result of tests indicated on official test reports from testing laboratories

Quality

- It is the extent to which the customer or users feel the product or service surpasses their needs and expectations.
- The characteristic of a product that provides a level of performance in terms of service and life.
- *Quality* in construction means that a project is completed within the defined guidelines set out in the Scope of Work.

Control

- It is usually used in relation to something in need of checking or regulating due to some important and compelling reasons.

- It is used to correct something which has gone wrong or in other words, control is instituted as a (corrective) preventive measure.

**** There is another form of control which is now widely and increasingly used in most industries to gauge the performance and excellence of work and product. It is the combination of the above two-words we have just defined, and the name is Quality Control.*

Quality Control

- ✓ The modern concept of Quality Control is that it is a system which involves the joint but independent efforts of the owner and the contractor to achieve the level of quality desired by the owner as established in the project specifications.

- ✓ The owner's task is to verify that the contractor's quality control system is functioning, and the completed structure is of the specified quality

- ✓ The contractor's task is to regulate, test and inspect the procedures, equipment, materials, and manpower so that the completed facility will comply with the requirements.

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Purpose of Quality Control

- to ensure the highest quality of work
- to extend the service life of any structure by constructing according to the prescribed plans and specifications
- to check and regulate the use of construction materials
- to economize the cost of construction of a structure

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Quality Control Procedure

In the construction or improvement projects of the Department of Public Works & Highways, the following quality control procedures are commonly used/practice:

1. Quality Control Program
2. Certificate of Quality Control Assurance
3. Pretesting of Manufactured Materials
4. Monthly Materials Report
5. Accomplishment of Quality Control Logbook
6. Inspection

Quality Control Program

- A program of quality control works in a certain project which involve inspection and testing of materials to be incorporated into a work.
- It specifies the minimum number of tests required for an item of work which corresponds to the quantities stated in the approved Program of Work of a project
- It is prepared by the concerned Materials Engineer of the owner and be approved by the Project Engineer assigned in the project.

Quality Control Program

QUALITY CONTROL PROGRAM

PROJECT: Restoration of Nueva Ecija – Pangasinan Road
Sta. 3+930 to Sta. 14+360, Nueva Ecija

A. Tests to be Performed

Item No.	Description	Unit	Quantity	No. of Test (Min.)
103 (1)	Structure Excavation	cu.m.	41	None
103 (6)	Exc. For Pipe Culverts	cu.m.	85	None
104 (1)	Emb. From Rd. Excavation	cu.m.	659	GPC – 1, D-7
104 (2)	Emb. From Borrow	cu.m.	1657	GPC –1, D-17
105 (1)	Subgrade Preparation	sq.m.	21,808	GPC –3, D-44
200 (1)	Agg. Subbase Course	cu.m.	4811	GP-16,C-4,D-64, Q-4, CBR-2
201	Agg. Base Course	cu.m.	7474	GP-25, C-5,Q-5, D-100, CBR-3
311	PCCP	sq. m.	34,181	
	a. Cement	bags	61,526	Q – 31
	b. Fine Agg.	cu. m.	3419	Q – 3, G- 46
	c. Coarse Agg.	cu. m.	5264	Q – 4, G-71
	d. Steel Bars	kg.	700	Q – 1
	e. Concrete	cu. m.		FS – 91 sets CB
	f. Completed PCCP, 200mm. , thk.			5 – cores/km/lane

Certificate of Quality Control Assurance

CERTIFICATE OF QUALITY CONTROL ASSURANCE

Project _____

Contractor _____

We hereby certify that we have conducted an inspection and verification on work accomplished on the above – mentioned project for the period _____. We further certify that we found that the quality of materials in the following items of work corresponding to the quantity accomplished conforms with the Standard Specifications and Special Provision of the Contract, viz:

Item No.	Description	Quantity Accomplished
_____	_____	_____
_____	_____	_____
_____	_____	_____

Note: To be submitted every quarter of the month

1 st report 1 – 7
2 nd report 8 – 15
3 rd report 16 – 22
4 th report 23 – 30/31

Pre-testing of Manufactured Materials

- to avoid delays of sending samples from the project to testing laboratories, samples of manufactured materials are obtained at the factory or at reputable supplier and tested at any of the DPWH or Accredited testing laboratories.
- Manufactured materials such as asphalt, cement, steel bars, paints and etc. particularly in big projects are pretested upon the instruction of Engineer and upon verification, the pretested materials are allowed to use upon the delivery at the job-site.

Monthly Materials Report

The Materials Engineer shall prepare and submit to the Project Engineer a Monthly Materials Report containing the individual tests conducted on the materials incorporated into the works and the status of tests accomplished based on the approved Quality Control Program. The report shall include the following:

a. Status of tests performed and the balanced of tests as required in the approved Quality Control Program
b. Summary of field and laboratory tests
c. Back-up test results of all tested construction materials
d. Photographs and Inspection Reports covering materials used during the month.

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Quality Control Logbook

- Project Control Logbook is being accomplished by the Project /Resident Engineer, stating the daily construction activities in the project, but another control logbook (Materials Quality Control Logbook) where the daily entries of activities undertaken relative to sampling, testing, inspection and other quality control activities/ comments in the project shall be properly encoded by the concerned Materials Engineer.
- Materials Quality Control Logbook shall contain all information and/ or observation relevant to materials quality control and shall be duly signed by the concerned Materials Engineer of the project.
- Logbook must always be kept available at all times for inspection.

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Quality Control Logbook

ILLUSTRATIVE EXAMPLE OF MATERIALS LOGBOOK

Date and Day ____ March 10,2005 / Thursday

Weather _____ A.M…Clear PM…….Clear

Project Activities:

a. Compaction of the fill materials, Item 105 was done with sheepsfoot roller at Sta. 1+600 to Sta. 2+000
b. Screening of coarse aggregate from Bauan River was done at the batching plant for use for Item 405
c. Preparation of reinforcing steel bars for concrete pouring of double culvert at Sta. 2+105.70

Materials Quality Control Activities:

a. Field Density test were performed by Contractor's men at Sta. 1+700 and Sta. 1+800 and supervised by government Materialsmen R. Cruz. We reported that two test were made and the samples for moisturre content were brought to the project laboratory, wieghed and dried under my supervision.

b. Sieve analysis was conducted on screened coarse aggregates for use for Item 405 for checking of the required gradation and the results was reviewed by me.

c. Checked the size and spacing of rebars installed at double culvert at Sta. 2+105.70 for compliance to approved plans.

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Who is responsible for Quality Control?

✓ Engineers and supervisors have the great responsibility in the implementation of the quality control, if it fails, they were to be blame, because they failed to transmit their knowledge of good quality control practices to the lower levels.

✓ Quality Control, if properly executed, it will more than pay itself, it is the key to more economical construction. Therefore, quality control is not a cost item; it is in reality an investment. It pays dividends to all, especially the owner and the builder.

Implementation of Quality Control

- **Project Engineers** has the overall responsibility in terms of materials quality control. He must have the technical know - how in materials testing and quality control to enable to check and regulate the use of construction materials and to economize the cost of materials in the project.

- **Materials Engineers** has the primary responsibility in the quality of materials which includes sampling, testing and inspection, recommends for the acceptance or rejection and recommends appropriate corrective measures to improved the quality of materials and works.

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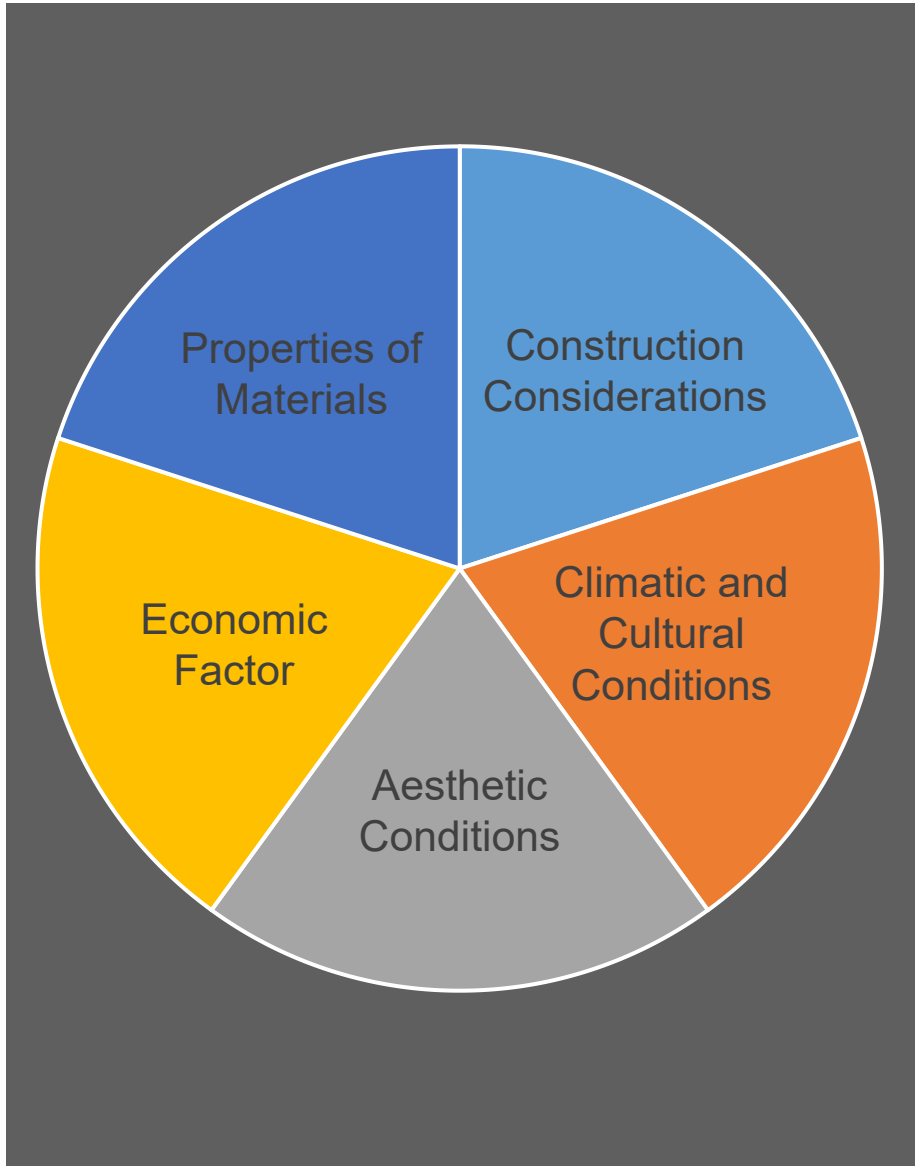
Classes of Selection Criteria

Properties of Materials
- ✓ Structural characteristics
- ✓ Physical Properties
- ✓ Mechanical Properties

Economic Factor
- ✓ Initial cost
- ✓ Maintenance cost
- ✓ Life-cycle cost



Construction Considerations
- ✓ Precast vs, cast-in-place
- ✓ Site accessibility
- ✓ Manpower availability
- ✓ Safety

Climatic and Cultural Conditions
- ✓ Local temperature
- ✓ Visual preservation
- ✓ Environmental sensitivity

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SUSTAINABLE DEVELOPMENT GOALS

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