

## **BUILDING OF TRAINING PROGRAM OF NON-DESTRUCTIVE TESTING FOR CONCRETE STRUCTURES**

**(Part 1: Radiographic testing; Ultrasonic pulse velocity measurement; Nuclear moisture-density gauge)**

*Nguyen Le Son, Phan Chanh Vu, Pham The Hung and Vu Huy Thuc*

Center for Nuclear Techniques, VAEC, Vietnam.

*ABSTRACT:* Non-destructive testing methods (NDT) have been identified as a strong candidate for remote sensing of concrete structures over recent years. This has accelerated the powerful development of the NDT techniques in Vietnam.

Hence, there is an urgent need to promote the awareness of NDT methods which could give an improved estimate of the condition concrete. As a result, the topic: “Building of training program of non-destructive testing for concrete structures” is a necessary duty, in aiming to build a unified training program, possibly satisfying the requirements on training as well as researching.

Under the framework of the basic VAEC project (CS/07/02-03), a training program for the first 03 NDT methods: 1. Radiographic testing; 2. Ultrasonic pulse velocity measurement; 3. Nuclear moisture- density gauge was prepared. The main products of this project include:

1. Set out 03 training notes for 03 methods.
2. Set out the practical exercises to train for 03 methods.
3. Editing a set of examination questions in aiming to familiarize with various questions in 03 trained methods.
4. Fabricating practical test specimens to demonstrate for 03 techniques.

### **INTRODUCTION**

Non-destructive testing methods (NDT) were identified as a strong candidate for remote sensing of concrete structures over recent years. In Viet Nam due to the door-opening policy and integration with the regional countries, the quality of the structure or component produced have felt as a key factor in long term economic and engineering success of that process. This has accelerated the powerful development of the NDT techniques in Vietnam.

Hence, there is an urgent need to promote the awareness of NDT methods which could give an improved estimate of the condition concrete. Center for nuclear techniques, Hochiminh City (CNT) has been active in the promotion of nondestructive testing (NDT) technology for many years. As a result, the topic: “*Building of training program of non-destructive testing for concrete structures*” is a necessary duty, in aiming to build a unified training program, possibly satisfying the requirements on training as well as researching.

Under the framework of the basic VAEC project (CS/07/02-03), a training program for the first 03 NDT methods: 1. Radiographic testing; 2. Ultrasonic pulse velocity measurement; 3. Nuclear moisture – density gauge was prepared. The main products of this project include:

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3. Editing a set of examination questions in aiming to familiarize with various questions in 03 trained methods.
4. Fabricating practical test specimens to demonstrate for 03 techniques.

**CONTENT OF THE PROJECT**

Included the following parts:

1. Editing the document set of 03 NDT methods for concrete structures: 1. Radiographic testing; 2. Ultrasonic pulse velocity measurement; 3. nuclear moisture – density gauge.
2. Set out the practical exercises to conduct in 03 methods: 1. Radiographic testing; 2. Ultrasonic pulse velocity measurement; 3. Nuclear moisture – density gauge.
3. Editing a set of examination questions, approximately over 700 questions on various issues of 03 techniques, in aiming to familiarize with various questions in 03 trained methods.
4. Fabricating practical test specimens to demonstrate for 03 techniques.

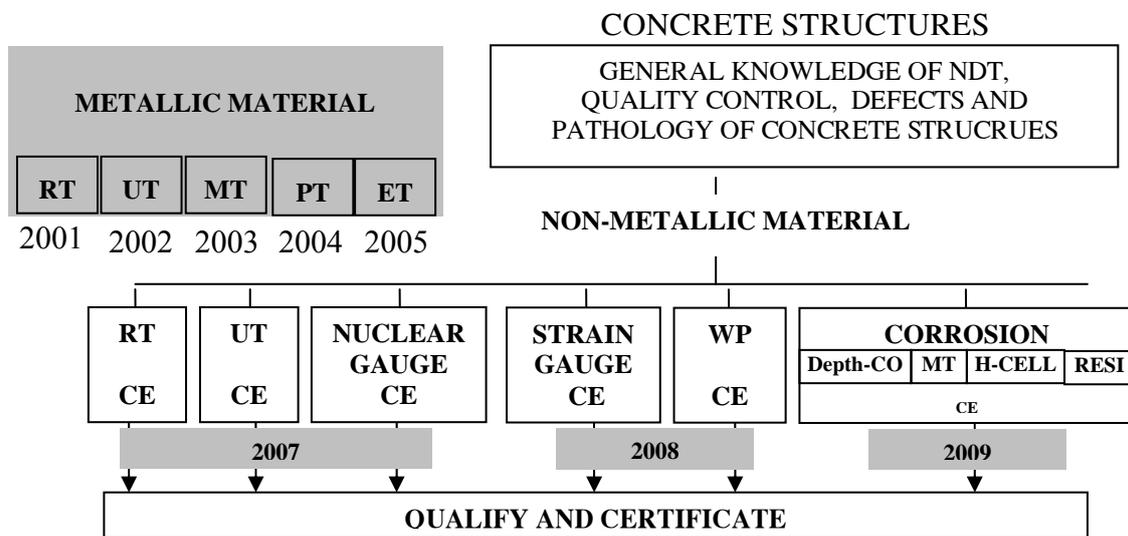
**MAIN PRODUCTS OF PROJECT**

**1. Editing the document set of 03 NDT methods for concrete structures:** 1. Radiographic testing; 2. Ultrasonic pulse velocity measurement; 3. Nuclear moisture – density gauge based on:

- a) “Guidebook on non-destructive testing of concrete structures”, Training course series No.17, IAEA, 2002.
- b) IAEA-TECDOC-628: “Training guidelines in Non-Destructive Testing Techniques”, Vienna 2002.
- c) ISO 9712-2005 (E): “Non-destructive testing Qualification and Certification of Personnel”.
- d) Viet Nam standards TCVN 5868-1965: Volume 1.

And training program complying with training system is discribed below.

**NDT TRAINING PROCEDURE**



### **Remarks**

RT-CE: Radiographic testing for concrete structures; UT-CE: Ultrasonic testing for concrete structures

Nuclear Gauge-CE: Nuclear moisture-density gauge

Strain Gauge-CE: Strain gauge measurement for concrete structures

WP-CE: Windsor probe test for concrete structures.

Corrosion-CE: Combined methods for corrosion situation of concrete structures (Depth-CO: Depth carbonation measurement; MT: Cover meter; H-CELL: half cell potential measurement; RESI: Resistivity measurement)

***1.1. The training note of nuclear moisture-density gauge for civil engineering:*** this document set included 8 chapters: 1. General knowledge of NDT, quality control, defects and pathology of concrete structures; 2. Terminology, physical principles; 3. Testing techniques and their limitations; 4. Equipment and accessories; 5. Calibration of the testing system; 6. Specific applications; 7. Codes, standards, specifications and procedures; 8. Personal safety and radiation protection. Minimum training hours include both practical and theory courses is 40 hours.

***1.2. The training note of radiographic testing for reinforced concrete:*** this document set included 6 chapters: 1. General knowledge of NDT, quality control, defects and pathology of concrete structures; 2. Terminology, physical principles; 3. Equipment- radiation sources, film recording and darkroom works; 4. Work parameters and conditions; 5. Selection of techniques according to standards and specific applications; 6. Personal safety and radiation protection. Minimum training hours include both practical and theory courses is 40 hours.

***1.3. The training note of ultrasonic pulse velocity measurement for concrete:*** included 6 chapters: 1. General knowledge of NDT, quality control, defects and pathology of concrete structures; 2. Terminology, physical principles; 3. Testing techniques and their limitations; 4. Equipment and accessories; 5. Specific applications; 6. Codes, standards, specifications and procedures. Minimum training hours include both practical and theory courses is 40 hours.

### **2. Set out the practical exercises to conduct in 03 methods:**

***2.1. There are 08 practical exercises for Nuclear moisture – density gauge:*** 1. to familiarize and to operate equipments, to get standard count; 2. to take the stability test; 3. to calibrate equipment for density measurement; 4. to calibrate equipment for moisture measurement. 5. to recheck equipment after calibration; 6. to study the useful depth of technique; 7. to practice on test specimens; 8. to practice of radiation safety.

***2.2. There are 05 practical exercises for Radiographic testing technique:*** 1. to familiarize and to operate equipments; 2. Darkroom; 3. to practice of radiation safety; 4. to examine the rebar in concrete; 5. to determine the sizes of rebar; 6. to detect the defects in concrete.

***2.3. There are 05 practical exercises for Ultrasonic testing technique:*** 1. to familiarize and to operate equipments; 2. to study the effects of the steel bars in concrete

on the ultrasonic pulse velocity; 3. to evaluate the in homogeneity of concrete; 4. to determine the depth of cracks in concrete; 5. to estimate the concrete strength.

**3. Editing a set of examination questions:** approximately over 800 questions on various issues of 03 techniques, in aiming to familiarize with various questions in 03 trained methods.

**4. Fabricating practical test specimens to demonstrate for 03 techniques:** 04 test specimens for radiographic testing techniques; 03 test specimens for ultrasonic testing technique: to study effects of steel bars; a set of 10 test specimens for ultrasonic testing technique: to estimate the concrete strength.

### CONCLUSION

The issue of this first document set is duly and timely, satisfying the needs of researching, learning of the 03 enhanced NDT methods for concrete structures, and also contributing its parts in training, teaching NDT systematically, textually and methodically in Vietnam now and later. This issue also establishes a fundamental for similar document sets that will be edited in the future, through that accelerating development of NDT techniques in Vietnam reaching a common level in the region.

### REFERENCE

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