

Non-Destructive Evaluation (NDE)

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Purpose of Inspection

In-service structures

Safety or not

NDE is the only method to inspect without damage to structures.

Advantage of NDE

- Selection of appropriate repairment and retrofitting method
- Life prediction by fracture mechanics
- Periodic inspection schedule

Types of NDE Methods				
2 main types f	2 main types for different types of cracks			
Surface-breaking cracks				
VT	: Visual Testing			
PT	: Dye Penetrant Testing			
MT	: Magnetic Particle Testing			
ET	: Eddy Current Testing			
UT UT	: Ultrasonic Testing			
	difficulty in detection because they are			
Embedded	cracks uncuty in detection because they are invisible!!			
UT	: Ultrasonic Testing			
L RT	: Radiographic Testing			



















UT – Application at Sites

Manual UT (MUT)



Automatic UT (AUT)



Research Works on NDE

Topics

- Detection of surface-breaking fatigue cracks Chitoshi Miki, Makoto Fukazawa, Masahiko Katoh, and Hisao Ohune: Journal of Structural Eng/Earthquake Eng., JSCE, No.386/1-8, pp. 329-337, 1987.10. (in Japanese)
- Effects of paint films on detectability of cracks by NDI methods

Makoto Fukazawa, Hisao Ohune, Masahiko Katoh and Chitoshi Miki: Journal of Structural Eng/Earthquake Eng., JSCE, No.398/I-10, pp. 395-404, 1988.10. (in Japanese)

- Detection of embedded fatigue cracks Jiro Tajima, Munehiro Fukui, Chitoshi Miki and Makoto Fukazawa: Journal of Structural Eng/Earthquake Eng., JSCE, No.386/I-8, pp. 427-434, 1987.10. (in Japanese)
- Current development of ultrasonic testing systems (2001~2004)

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Surface-Breaking Fatigue Cracks Fatigue cracks initiated at toes of fillet welds















Summary

Minimum detectable sizes of defects by NDI methods

For MT, ET, PT

	S	ize	Detection of
	e	a	crack(a≥5mm)
MT	<5mm	< 0.5mm	Overestimated
ECT	6mm	1.0mm	Overestimated
РТ	10mm	2.5mm	Underestimated

For UT

	Minimum Detectable Depth	Accuracy
Corner Echo	1mm	
Tip Echo	2.5mm	±1mm

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Paint Films

Most of steel bridge members are coated with paint. Paint films prevent steel bridges from weathering corrosion.



Specimens with Paint Films



	Painting Material	Standard amount used (g/cm²)	Painting Interval (20°C)		
1st layer	Etching Primer	Spray 130	12H-3M	Total	
2nd layer	Rust Resisting Paint	Spray 170	2D-1M	Thickness	
3rd layer	Rust Resisting Paint	Spray 170	2D-6M	_=100 µm	
4th layer	Phthalic Resin Coating	Brush 110			
5th layer	Phthalic Resin Coating	Brush 105	24H-15D		
5 Layers					
Layers					
	1st layer 2nd layer 3rd layer 4th layer 5th layer Layers	Painting Material Painting Material Etching Primer Ind layer Rust Resisting Paint Ath layer Phthalic Resin Coating Sth layer Phthalic Resin Coating Layers	Painting Material Standard amount used (g/cm2) 1st layer Etching Primer Spray 130 1nd layer Rust Resisting Paint Spray 170 3rd layer Rust Resisting Paint Spray 170 3rd layer Phthalic Resin Coating Brush 110 5th layer Phthalic Resin Coating Brush 105 Layers Future State State	Painting Material Standard amount used (g/cm²) Painting interval (20°C) 1st layer Etching Primer Spray 130 1st layer Rust Resisting Paint Spray 170 3rd layer Rust Resisting Paint Spray 170 3rd layer Phthalic Resin Coating Brush 110 Sth layer Phthalic Resin Coating Brush 105	







Inspection Results – PT (I)













Summary

Detectable crack length limit

NDT	Minimum Detectable Length, mm		
	Paint	Nonpaint	Accuracy
VT	4.0	8.0	Poor accuracy(varied widely)
MT	(4.0)	2.0	Appropriate
РТ	(4.0)	8.0	Underestimated
UT	5.0	6.0	Overestimated
ECT	5.0	5.0	None

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Inspection Results

Compare with actual size

Crack	Estimated size	Actual Size
	byUI[mm]	[mm]
С-5	19.3	19.1
C-6	6.2	6.3
A-9	5.9	5.9

Good agreement High accuracy of crack size estimation













Ultrasonic Inspection System

















