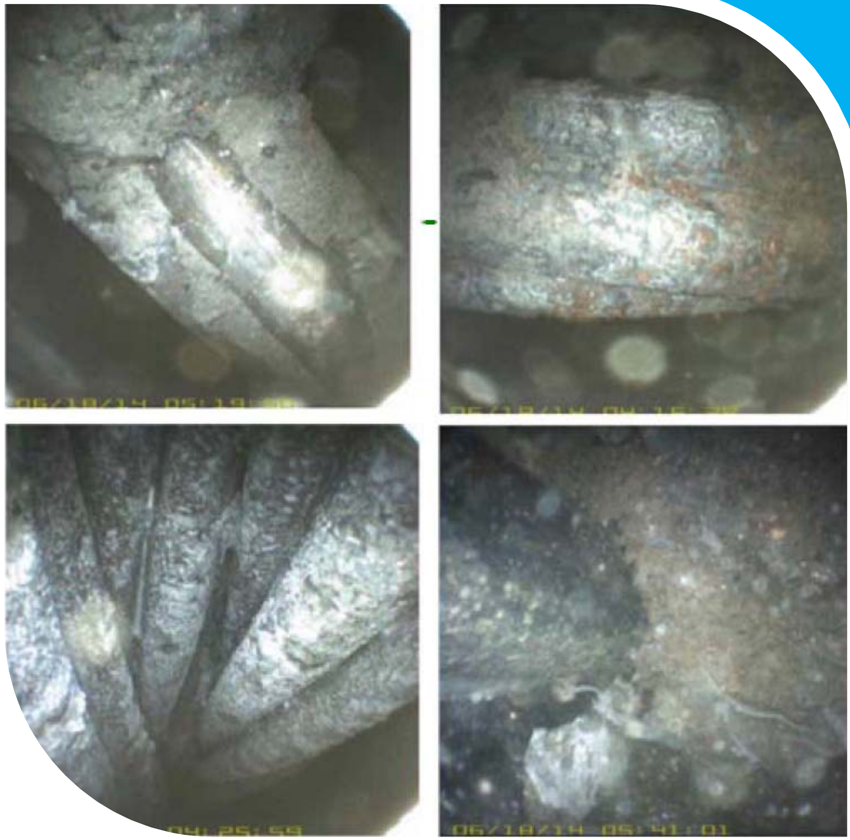


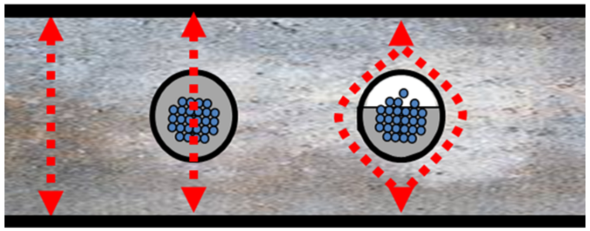
내부 텐던 검사 및 보수

내부 텐던 검사

- 비파괴 검사
- 천공(내시경) 검사
- 개복 검사
- 함수량 검사

내부 텐던 검사 : 비파괴

- Main magnetic flux method
- Magnetic flux leakage method
- Pulsed eddy current examination method
- Magnetostrictive sensor technology
- Microwave thermoreflectometry
- Remnant magnetic system
- Vibration method
- Ultrasonic pulse velocity
- Acoustic emission
- Computerized tomography
- Impact-echo
- Sounding



내부 텐던 검사 : 천공(내시경)

- 특징
  - 비교적 구조물과 텐던의 손상 위험이 적다
  - 덕트 개복 검사에 비해 검사 용이

텐던 위치 확인(GPR)

↓

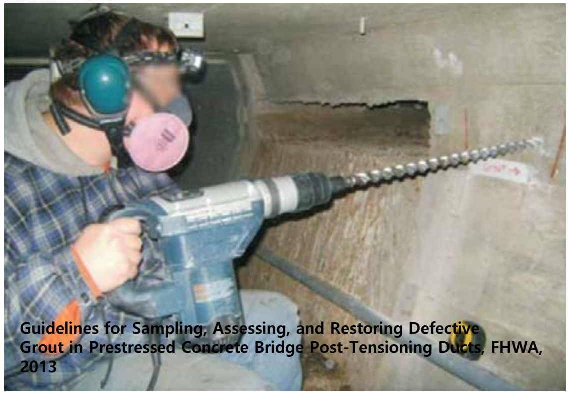
콘크리트 피복 확인

↓

점검 홀 천공

↓

내시경 검사

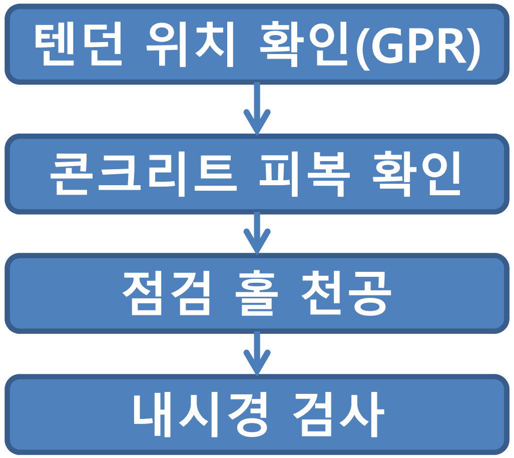


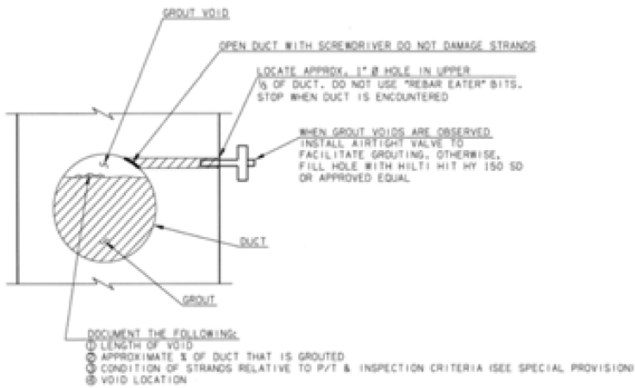
Guidelines for Sampling, Assessing, and Restoring Defective Grout in Prestressed Concrete Bridge Post-Tensioning Ducts, FHWA, 2013

DAOR E&C CO., LTD.

내부 텐던 검사 : 천공(내시경)

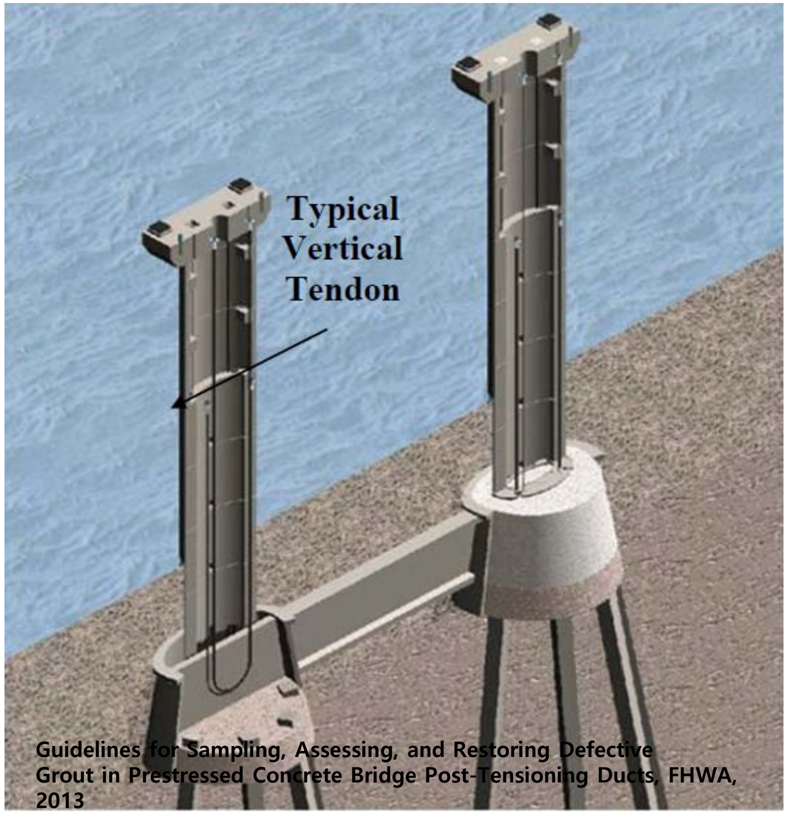
- 비교적 구조물과 텐던의 손상 위험이 적다
- 덕트 개복 검사에 비해 검사 용이



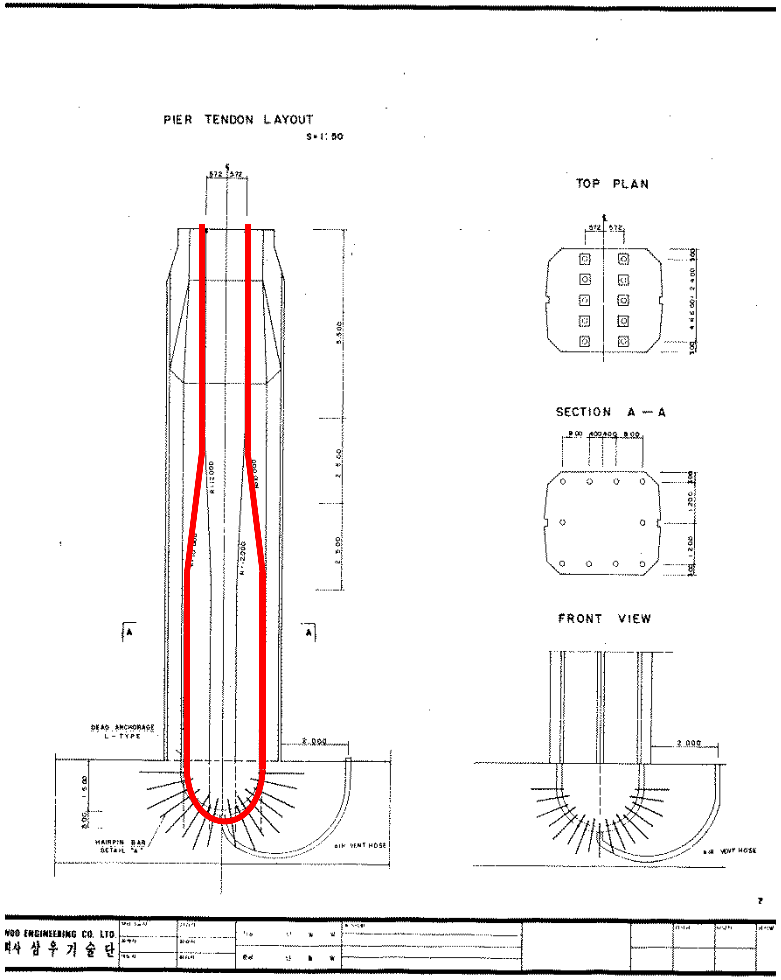


내부 텐던 검사 : 천공(내시경)

- 수직 텐던



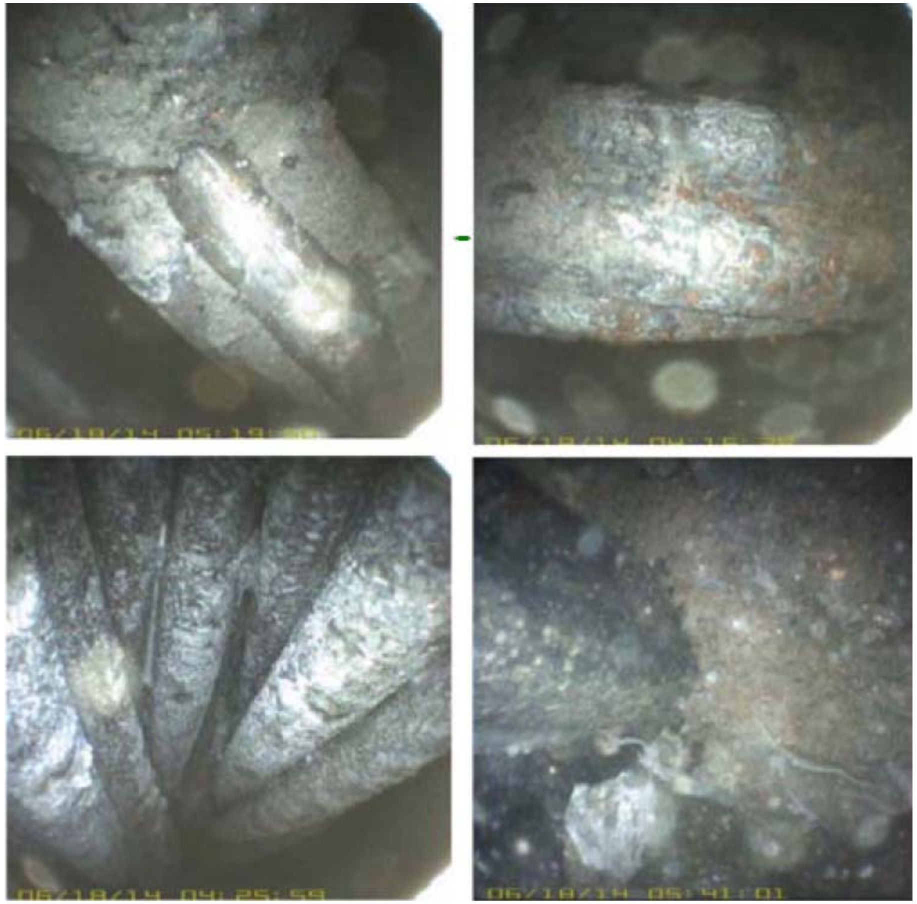
Guidelines for Sampling, Assessing, and Restoring Defective Grout in Prestressed Concrete Bridge Post-Tensioning Ducts, FHWA, 2013



DAOR E&C CO., LTD.

내부 텐던 검사 : 천공(내시경)

- 수직 텐던



DAOR
DAOR E&C CO., LTD.

내부 텐던 검사 : 개복

- 철근 및 강연선 손상 주의
- 복원 재료 선정

텐던 위치 확인(GPR)

↓

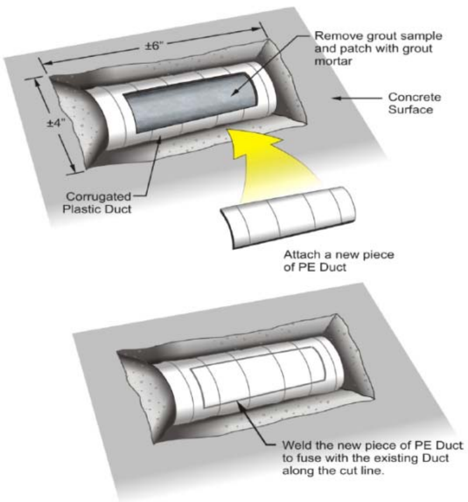
콘크리트 파취(철근)

↓

덕트 개복

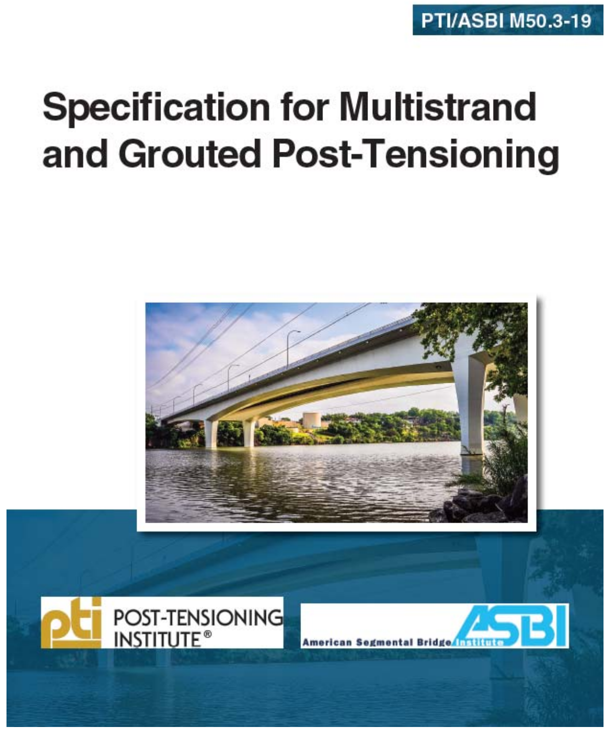
↓

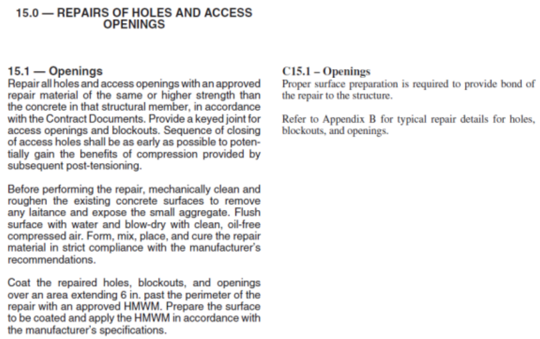
육안 및 내시경 검사



내부 텐던 검사 : 개복

- 보수용 천공부와 개복부 보수(PTI/ASBI M50.3-19)
  - 구조 부재 이상 강도의 보수 재료
  - 턱이 있는 형태로 복구
  - 인장에 대한 응력 도입을 위해 최대한 빠르게 복구
  - 복구 전 청결과 거친 표면 유지
  - 물청소 후 건조
  - 보수 재료 충전
  - 보수 표면 코팅(HMWMS: High Molecular Weight Methacrylate)





15.0 — REPAIRS OF HOLES AND ACCESS OPENINGS

15.1 — Openings
Repair all holes and access openings with an approved repair material of the same or higher strength than the concrete in that structural member, in accordance with the Contract Documents. Provide a keyed joint for access openings and blockouts. Sequence of closing of access holes shall be as early as possible to potentially gain the benefits of compression provided by subsequent post-tensioning.

Before performing the repair, mechanically clean and roughen the existing concrete surfaces to remove any laitance and expose the small aggregate. Flush surface with water and blow-dry with clean, oil-free compressed air. Form, mix, place, and cure the repair material in strict compliance with the manufacturer's recommendations.

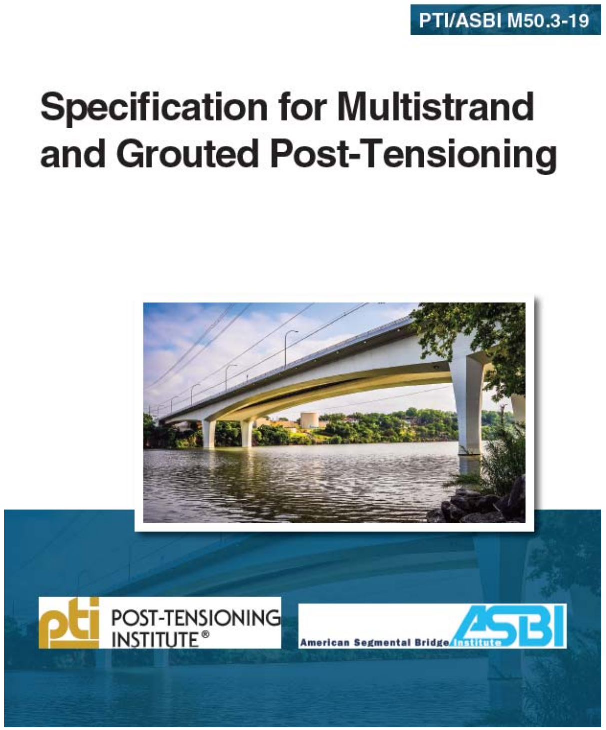
Coat the repaired holes, blockouts, and openings over an area extending 6 in. past the perimeter of the repair with an approved HMWM. Prepare the surface to be coated and apply the HMWM in accordance with the manufacturer's specifications.

C15.1 – Openings
Proper surface preparation is required to provide bond of the repair to the structure.

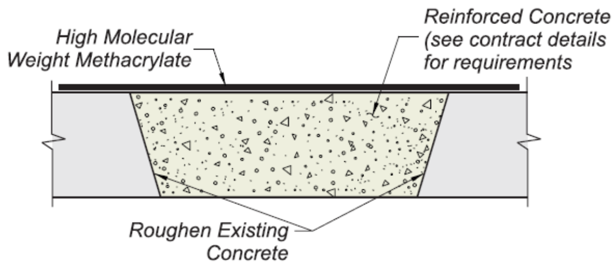
Refer to Appendix B for typical repair details for holes, blockouts, and openings.

내부 텐던 검사 : 개복

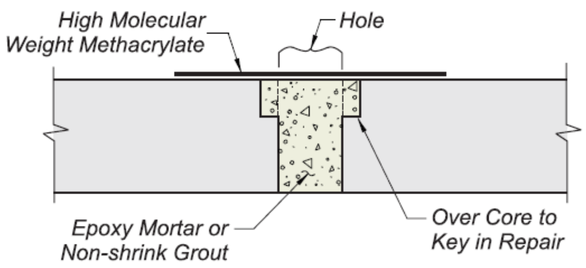
- 콘크리트 보수재료 → 보수재료
- 표면처리(그리트 블라스팅, 워터 블라스팅) 방법 삭제



Access Opening and Blockouts



Hole in Slab



15.0 — REPAIRS OF HOLES AND ACCESS OPENINGS

15.1 — Openings
Repair all holes and access openings with an approved repair material of the same or higher strength than the concrete in that structural member, in accordance with the Contract Documents. Provide a keyed joint for access openings and blockouts. Sequence of closing of access holes shall be as early as possible to potentially gain the benefits of compression provided by subsequent post-tensioning.

Before performing the repair, mechanically clean and roughen the existing concrete surfaces to remove any laitance and expose the small aggregate. Flush surface with water and blow-dry with clean, oil-free compressed air. Form, mix, place, and cure the repair material in strict compliance with the manufacturer's recommendations.

Coat the repaired holes, blockouts, and openings over an area extending 6 in. past the perimeter of the repair with an approved HMWM. Prepare the surface to be coated and apply the HMWM in accordance with the manufacturer's specifications.

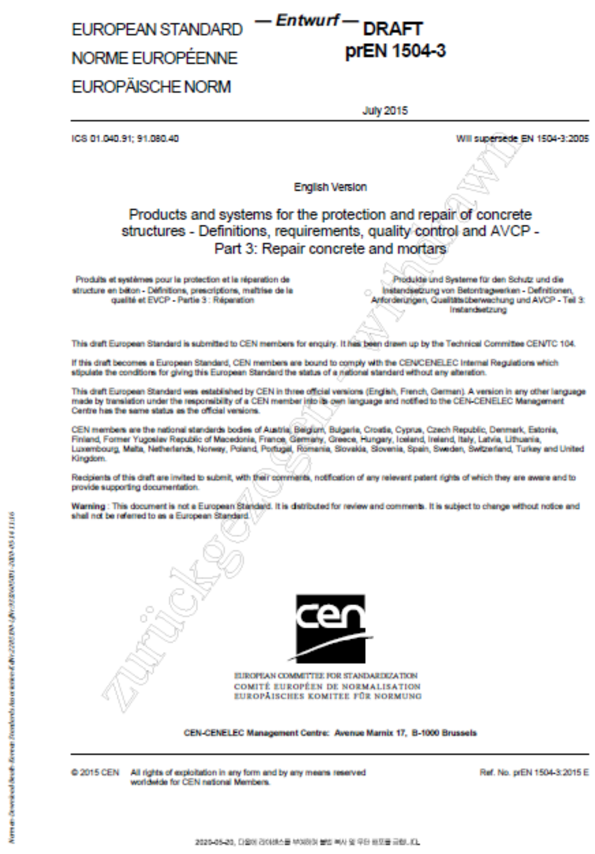
C15.1 – Openings
Proper surface preparation is required to provide bond of the repair to the structure.

Refer to Appendix B for typical repair details for holes, blockouts, and openings.

내부 텐던 검사 : 개복

- 개복부 보수재료 (EN 1504-3:2015)
- 보수 콘크리트와 몰탈
- 물리적 성질

	시험항목		시험법	성능기준(Class R4)
1	Compressive strength		EN 12190	≥ 45 MPa
2	Adhesive bond		EN 1542	≥ 2.0 MPa
3	Elastic modulus		EN 13412	≥ 20 GPa
4	Flexural strength		EN 1015–11	≥ 8 MPa
5		Part 1 De-icing salt immersion Bond strength after 50 cycles	EN 13687–1	
6	Thermal compatibility	Part 2 Thunder shower Bond strength after 30 cycles	EN 13687–2	≥ 2.0 MPa
7		Part 4 Dry cycling Bond strength after 30 cycles	EN 13687–4	
8	Shrinkage		EN 12617–4	≤ 0.90 %o
9	Swelling		EN 12617–4	≤ 0.30 %o after 28 d
10	Creep in compression		EN 13584	value declaration


EUROPEAN STANDARD — Entwurf — DRAFT
NORME EUROPÉENNE prEN 1504-3
EUROPÄISCHE NORM

July 2015

ICS 01.040.91; 91.080.40 Will supersede EN 1504-3:2005

English Version

Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and AVCP - Part 3: Repair concrete and mortars

Produits et systèmes pour la protection et la réparation de structure en béton - Définitions, prescriptions, maîtrise de la qualité et EVCP - Partie 3 : Réparation

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Definitionen, Anforderungen, Qualitätsüberwachung und AVCP - Teil 3: Instandsetzung

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 104.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

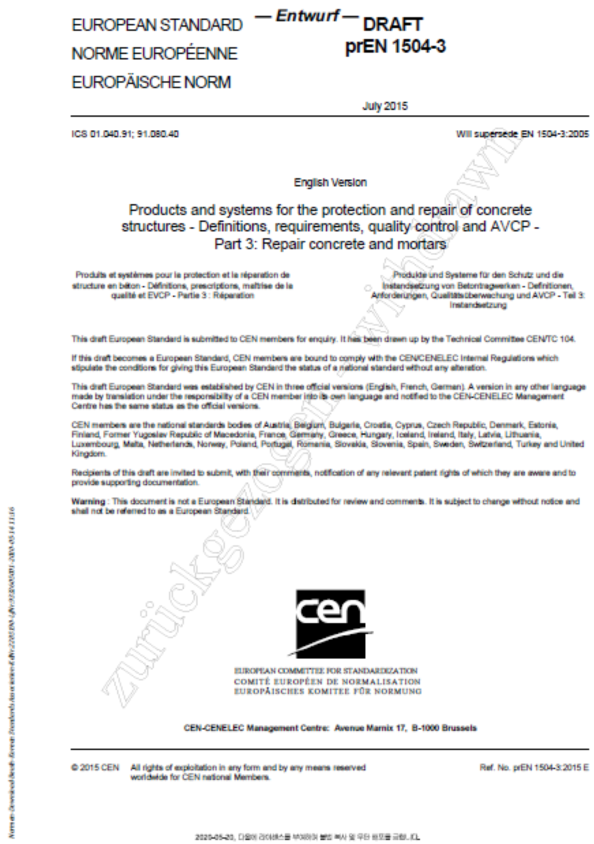
 Ref. No. prEN 1504-3:2015 E

DAOR E&C CO., LTD.

내부 텐던 검사 : 개복

- 개복부 보수재료 (EN 1504-3:2015)
- 보수 콘크리트와 몰탈
- 내구성

	시험항목	시험법	성능기준(Class R4)
1	Chloride ion content	EN 1015–17	≤ 0.05 %
2	Carbonation resistance	EN 13295	d_k ≤ control concrete (MC (0.45))
3	Coefficient of thermal expansion	EN 1770	value declaration
4	Capillary absorption	EN 13057	≤ 0,5 $kgm^{-2}h^{-0,5}$
5	Frost resistance	CEN/TS 12390–9	Class F1: ≤ 600 gm^{-2} Class F2: ≤ 1 200 gm^{-2}
6	Corrosion behaviour	EN 480–14 with EN 934–1	No evidence of corrosion-promoting effect.
7	Skid resistance	EN 13036–4	Class I: > 40 units wet tested Class II: > 40 units dry tested Class III: > 55 units wet tested



EUROPEAN STANDARD — *Entwurf* — **DRAFT**
NORME EUROPÉENNE **prEN 1504-3**
EUROPÄISCHE NORM

July 2015

ICS 01.040.91; 91.080.40 Will supersede EN 1504-3:2005

English Version

Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and AVCP - Part 3: Repair concrete and mortars

Produits et systèmes pour la protection et la réparation de structure en béton - Définitions, prescriptions, maîtrise de la qualité et EVCP - Partie 3 : Réparation

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Definitionen, Anforderungen, Qualitätsüberwachung und AVCP - Teil 3: Instandsetzung

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 104.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

 Ref. No. prEN 1504-3:2015 E

내부 텐던 검사 : 개복

- 개복부 보수재료 (KS F 4042:2012)
- 콘크리트 구조물 보수용 폴리머 시멘트

	시험항목		시험법	성능기준
1	시멘트 혼화용 폴리머의 고형분(%)			표시값 ±1 % 이내
2	휨 강도(N/㎟)			6.0 이상
3	압축 강도(N/㎟)			20.0 이상
4	부착 강도(N/㎟)	표준 조건		1.0 이상
5		온ㆍ냉 반복 후		1.0 이상
6	내알칼리성			압축 강도 20.0 N/㎟ 이상
7	중성화 저항성(mm)			2.0 이하
8	투수량(g)			20.0 이하
9	물 흡수 계수[kg/(㎡ㆍ$h^{0.5}$)]			0.5 이하
10	습기 투과 저항성(Sd)			2 m 이하
11	염화물 이온 침투 저항성(Coulombs)			1 000 이하
12	길이 변화율(%)			±0.15 이내


KS F 4042

KSKSKSKS
KSKSKSK
KSKSKS
KSKSK
KSKS
KSK
KS

KS

콘크리트 구조물 보수용
폴리머 시멘트 모르타르
KS F 4042:2012
(2017 확인)

산 업 표 준 심 의 회
2012년 7월 23일 개정

DAOR E&C CO., LTD.

내부 텐던 검사 : 개복

- 개복부 보수재료 (KS F 4043:2008)
- 구조물 보수용 에폭시 수지 모르타르

	시험항목		시험법	성능기준
1	작업 가능 시간(분)		5.3	표시값의 ±20 % 이내
2	휨 강도(N/㎟)		5.5	10.0 이상
3	압축 강도(N/㎟)	표준	5.6	40.0 이상
4		알칼리 침지 후		
5	부착 강도(N/㎟)	60℃	5.7	1.5 이상
6		20℃		
7		5℃		
8		온・냉 반복 후		
9	투 수 량(g)		5.8	0.5 이하
10	염화물 이온 침투 저항성 (Coulombs)		5.9	1 000 이하
11	길이 변화율(%)		5.1	±0.15 이내


KS F 4043

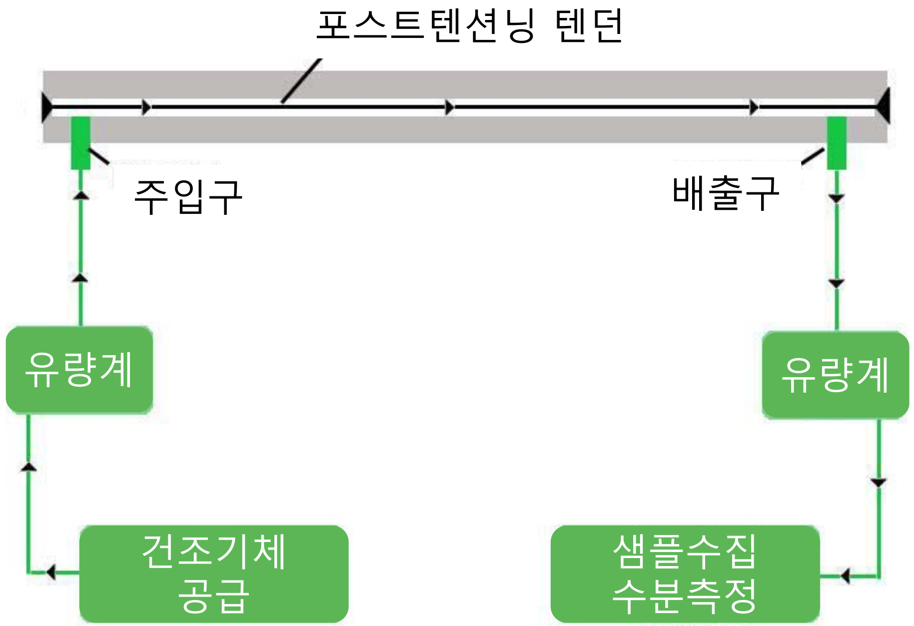
KSKSKSKS
KSKSKSK
KSKSKS
KSKSK
KSKS
KSK
KS
KS

콘크리트 구조물 보수용 에폭시 수지 모르타르

KS F 4043 : 2008
(2018 확인)

산 업 표 준 심 의 회
2008년 12월 30일 개정

내부 텐던 검사 : 함수량



텐던 주입구/배출구 설치

↓

주입구를 통해 건조 기체 주입

↓

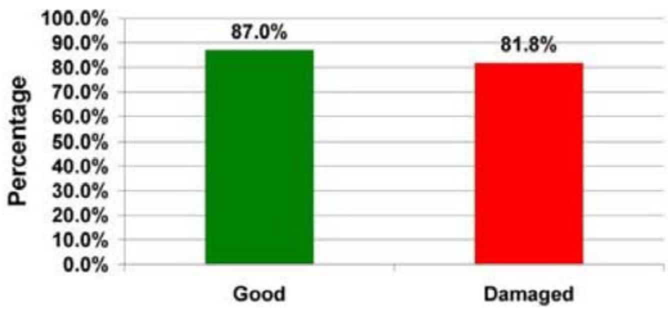
배출구에서 함수량 측정

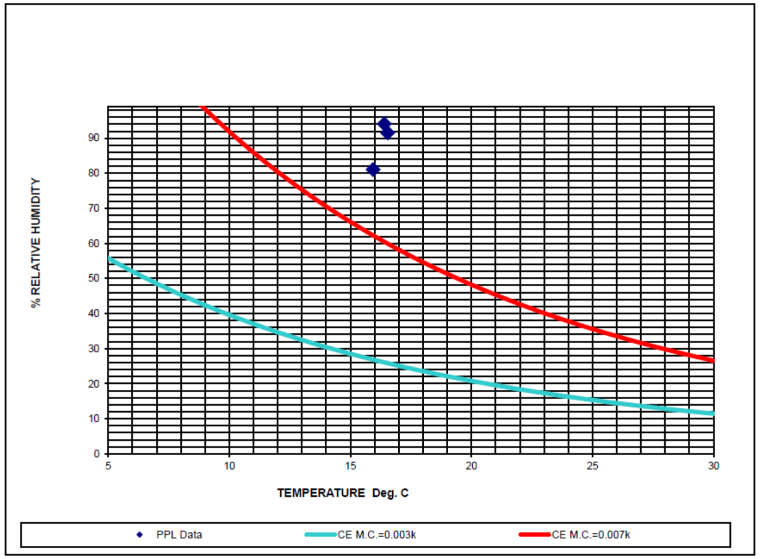
DAOR E&C CO., LTD.

내부 텐던 검사 : 함수량

- 함수량 평가기준

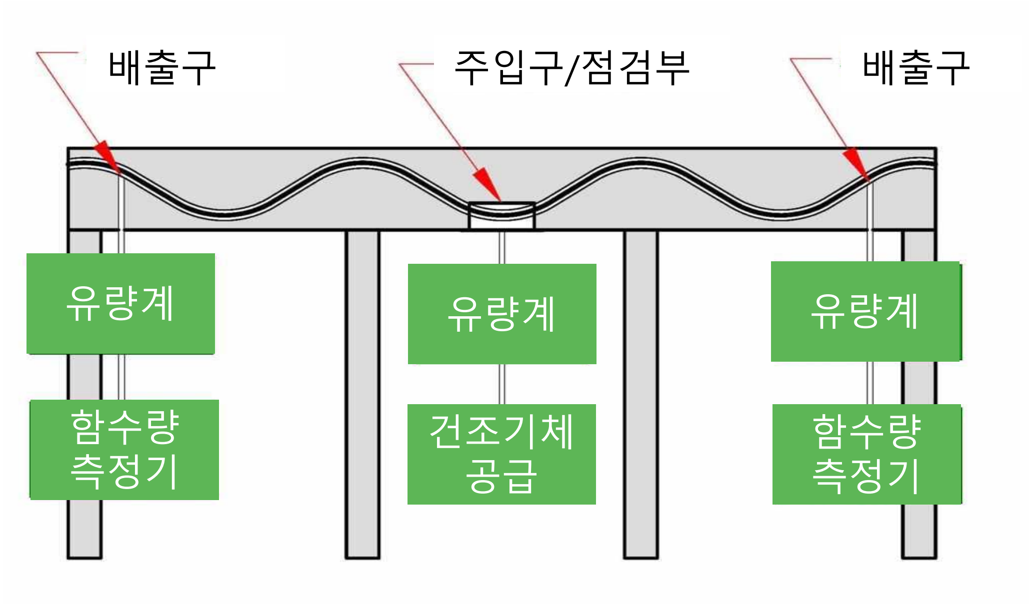
등급	구분	수분함수량
1	건조	< 0.3%
2	보통	0.3%~0.7%
3	습윤	> 0.7%

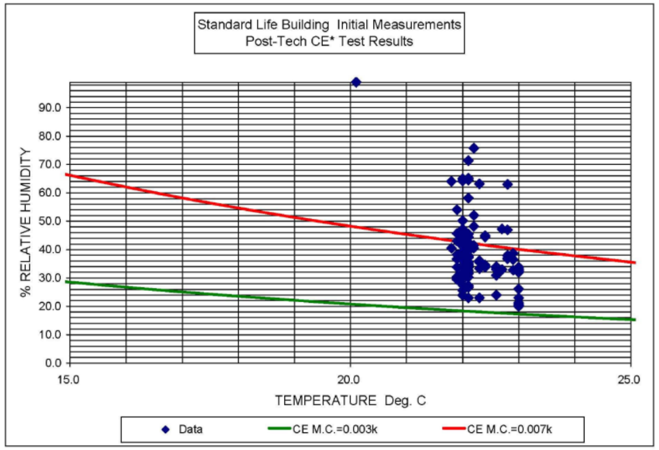


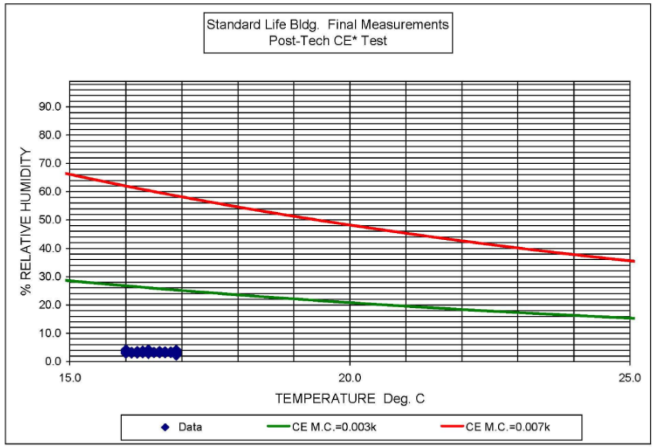


내부 텐던 검사 : 함수량

- 텐던 건조(Dehumidity) 작업







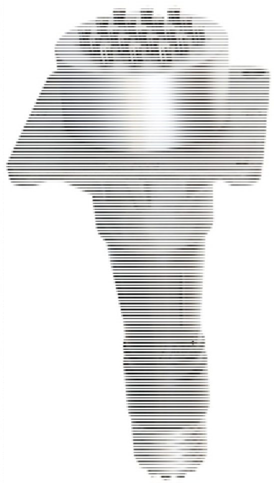
텐던 보수

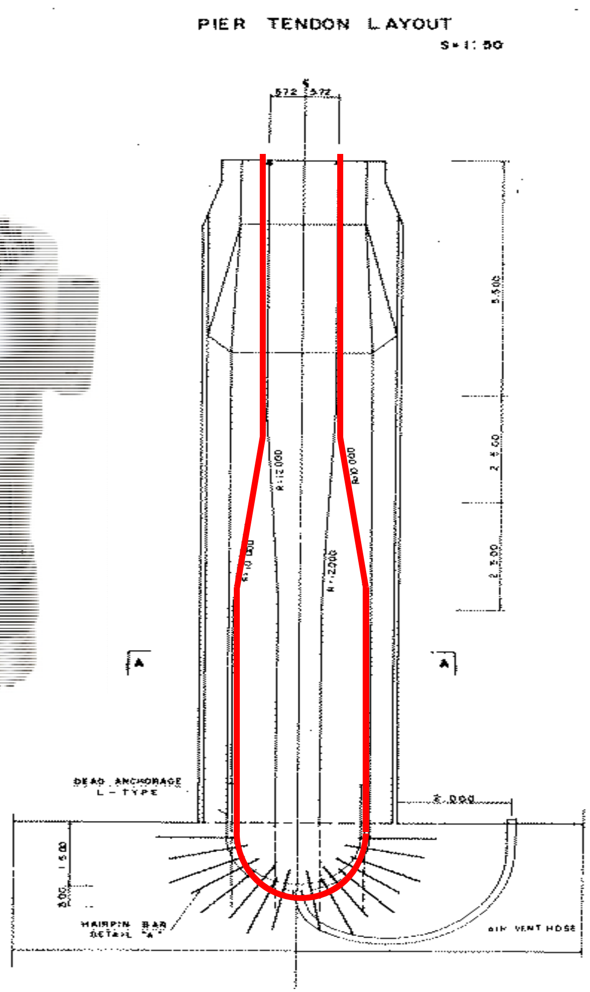
- 보수그라우트
  - 압력(Pressure) 주입
  - 진공(Vacuum) 주입
  - 압력+진공(Pressure+Vacuum) 주입
- PTI Impregnation
- 희생양극(Anode protection)

텐던 보수 : 보수 그라우트

- 수직텐던 보수 그라우트
  - 주입구 확보 및 접근 가능
  - 압력(Pressure) 주입

정착부 천공
↓
공극 깊이 확인
↓
주입구 천공
↓
보수그라우트 주입





DAOR
DAOR E&C CO., LTD.

텐던 보수 : 보수 그라우트

- 수직텐던 보수 그라우트
  - 주입구 확보 및 접근 불가
  - 저수조를 사용한 주입
  - 특별한 그라우트 배합 설계
  - 진공 주입 병행 고려

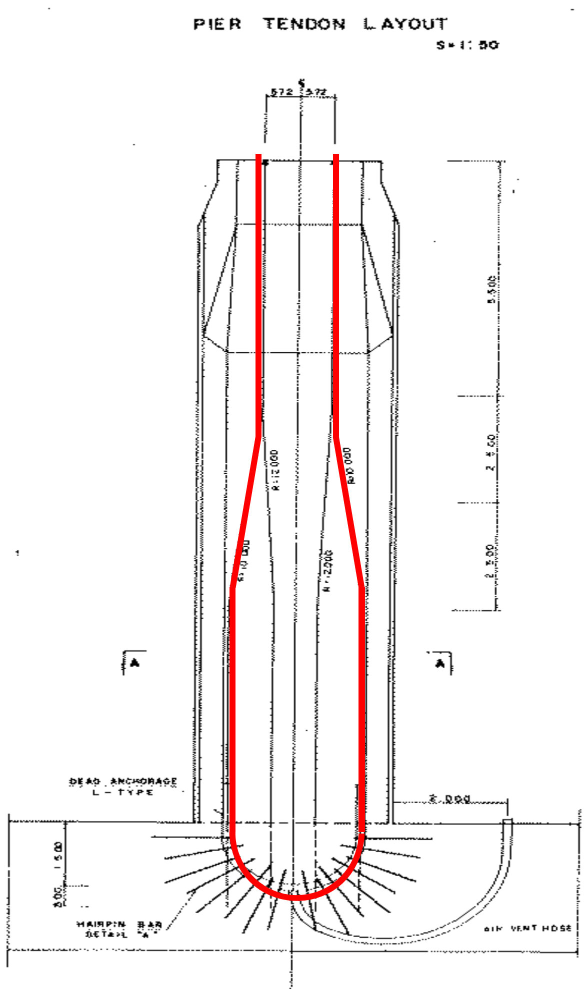
정착부 천공

↓

그라우트 저수조 설치

↓

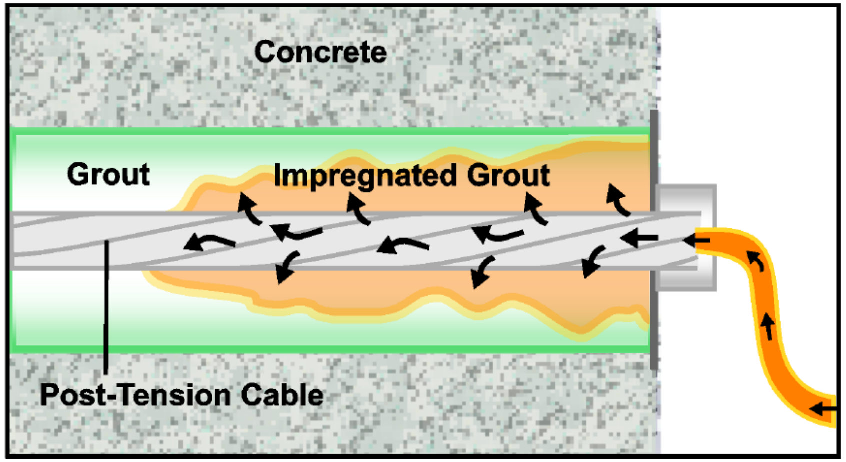
보수그라우트 주입



DAOR E&C CO., LTD.

텐던 보수 : PTI Impregnation

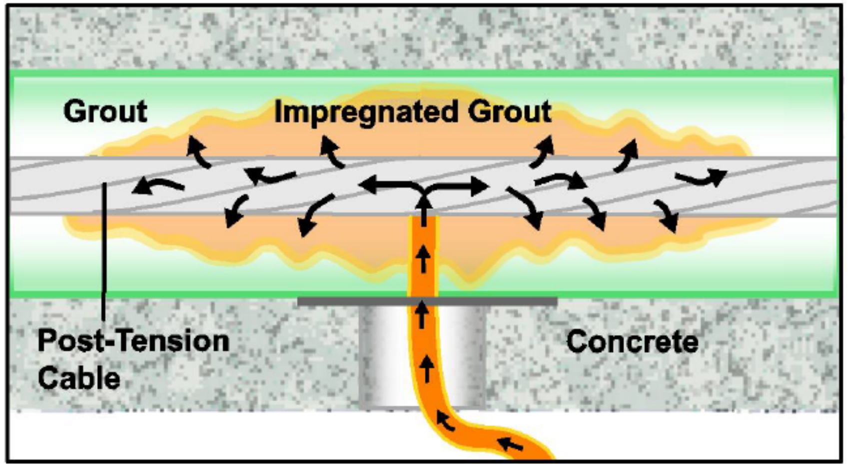
- PTI Impregnation
- 정착부 주입



DAOR E&C CO., LTD.

텐던 보수 : PTI Impregnation

- PTI Impregnation
- 텐던 주입



DAOR E&C CO., LTD.

텐던 보수 : 희생양극(Anode)

- 텐던 공극 보수 당시 재료는 고성능 그라우트 사용
- 보고서에 따르면 기존 그라우트와 채움 보수 그라우트의 경계면에서 파단 발생
- 이 파단 현상으로 인해 보수 그라우트와 기존 그라우트와의 경계면에서 강연선의 부식에 심각한 영향을 미칠 수 있다는 사실 확인
- 신구 그라우트 간의 경계면에서 전위차에 의한 부식이 발생 가능

"EFFECT OF VOIDS IN GROUTED, POST-TENSIONED CONCRETE BRIDGE CONSTRUCTION" 2009

for research into the influence of new repair grouts on tendon corrosion, especially at the interface between existing and repair grouts. This interface could possibly generate a galvanic corrosion cell. However, the validity of this argument needs to be investigated. It was also observed that many tendons were not completely sealed during the original construction. This likely enabled moist air from the environment to enter the voided ducts and accelerate corrosion of the exposed tendons.

Figure 2-7. Varina-Enon Bridge, over the James River, Virginia (Roadstothefuture 2009).

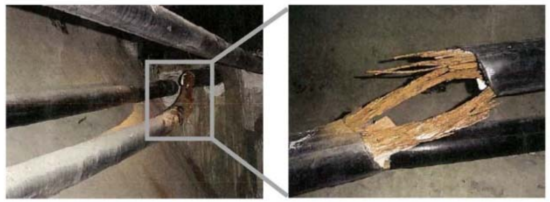


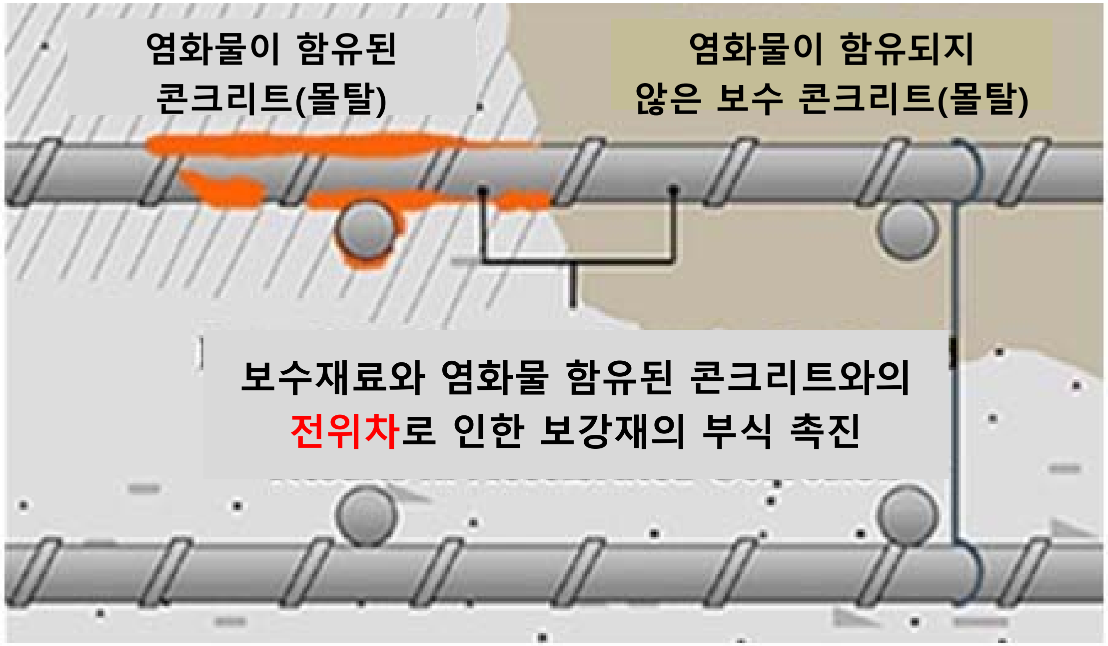
Figure 2-8. Tendon Corrosion in Varina-Enon Bridge, Virginia (Hansen 2007).

DAOR E&C CO., LTD.

텐던 보수 : 희생양극(Anode)

- Patch-accelerated corrosion :

  콘크리트 공극 또는 단면 보수용 패치(Patch)와 기존 콘크리트의 전위차에 의해 보강재(강재)의 부식이 촉진되는 현상



"Embedded Galvanic Anodes Increase Sustainability of Reinforced Concrete Structures" 2003

pucks are primarily used in rehabilitation applications such as patch repairs (Figure 1), and joints between new and existing concrete. They are typically installed at the perimeter of a repair area by using their built-in tie-wires to fasten them to the exposed reinforcing steel. When a suitable concrete or mortar is placed around the anode, its core will begin to sacrificially protect the surrounding reinforcement.

A similar cylindrical anode is also available, 6.4 centimeters long by 4.3 centimeters in diameter. The primary differences between this anode and the puck are in its exterior shape and the shape of its zinc core. This anode is designed for installation in a 5 centimeter wide drilled hole (Figure 2) in mechanically sound concrete. Its core shape has been designed with multiple fins to maximize anode surface area. This anode is connected to the reinforcing steel by a single steel lead wire. These anodes are used primarily in applications where corrosion activity is already occurring or expected to occur but has not progressed to the point of causing physical deterioration.

The most recent development is the manufacture of an even smaller cylindrical anode, or "pellet". The pellet is 19 mm in diameter, and 25 mm long. It is placed in a 19 mm hole similarly to the larger cylindrical anode. Aside from its compact size, the pellet anode differs significantly in its composition having no outer cementitious shell. In the previous two anode configurations, the zinc core is surrounded by a cementitious shell which contains chemical additives that maintain the zinc in an electrochemically "active" state. In order to reduce the size of the pellet a new manufacturing process was used incorporating the activators into the zinc and eliminating the need for a bulky shell. There are currently two versions of this anode available, the standard anode and one with a built-in lead wire. Commonly installation is accomplished by drilling a 19 mm hole to make direct contact with the reinforcing steel (Figure 3). After removing all dust and debris from the hole, the anode is placed in the hole and driven against the reinforcing steel with a mallet and punch. The anode deforms against the steel, simultaneously making an electrical and mechanical connection. The remainder of the hole is then filled with a suitable grout material. The alternate version of the pellet has an attached lead wire. This version of the anode is used in situations of very shallow concrete cover (less than 38 mm) when there is not enough depth to place the anode on "top" of the reinforcing steel. These anodes are installed in a similar manner to the cylindrical anodes, with a two-hole method.

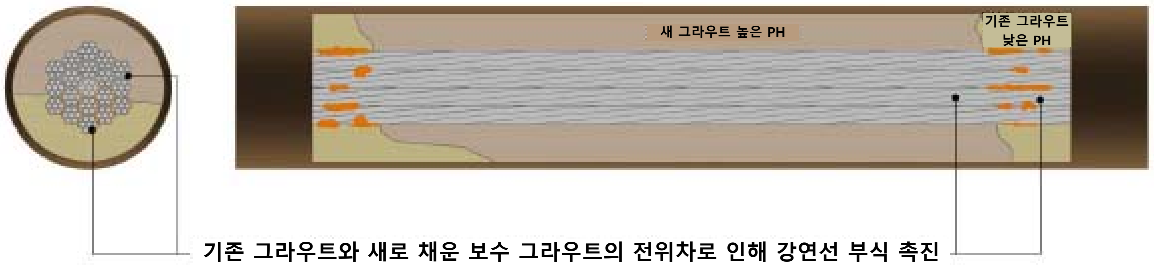
Applications

Repair and protection of concrete structures offers many unique challenges from a corrosion perspective. In particular the "Ring-Anode" effect, also called the "Halo" effect is a phenomenon that is frequently overlooked but is a common cause of premature patch-failure. The principles of chloride-induced corrosion are well understood, and corrosion is known to be an electrochemical reaction. Much like a battery, all corrosion cells have an anode and a cathode. During the corrosion process the anodic portion of steel is converted to iron oxide (rust). The ring-anode effect results in an increase in corrosion activity caused by the electrochemical incompatibility created between reinforcing steel within a patch area and the steel embedded within the surrounding

4

텐던 보수 : 희생양극(Anode)

- "Ring-Anode" 효과 또는 "Halo" 효과에 의해서 콘크리트나 몰탈 보수된 위치에서 철근이나 강연선 등 매립 강재의 부식 촉진



"Embedded Galvanic Anodes Increase Sustainability of Reinforced Concrete Structures" 2003

pucks are primarily used in rehabilitation applications such as patch repairs (Figure 1), and joints between new and existing concrete. They are typically installed at the perimeter of a repair area by using their built-in tie-wires to fasten them to the exposed reinforcing steel. When a suitable concrete or mortar is placed around the anode, its core will begin to sacrificially protect the surrounding reinforcement.

A similar cylindrical anode is also available, 6.4 centimeters long by 4.3 centimeters in diameter. The primary differences between this anode and the puck are in its exterior shape and the shape of its zinc core. This anode is designed for installation in a 5 centimeter wide drilled hole (Figure 2) in mechanically sound concrete. Its core shape has been designed with multiple fins to maximize anode surface area. This anode is connected to the reinforcing steel by a single steel lead wire. These anodes are used primarily in applications where corrosion activity is already occurring or expected to occur but has not progressed to the point of causing physical deterioration.

The most recent development is the manufacture of an even smaller cylindrical anode, or "pellet". The pellet is 19 mm in diameter, and 25 mm long. It is placed in a 19 mm hole similarly to the larger cylindrical anode. Aside from its compact size, the pellet anode differs significantly in its composition having no outer cementitious shell. In the previous two anode configurations, the zinc core is surrounded by a cementitious shell which contains chemical additives that maintain the zinc in an electrochemically "active" state. In order to reduce the size of the pellet a new manufacturing process was used incorporating the activators into the zinc and eliminating the need for a bulky shell. There are currently two versions of this anode available, the standard anode and one with a built-in lead wire. Commonly installation is accomplished by drilling a 19 mm hole to make direct contact with the reinforcing steel (Figure 3). After removing all dust and debris from the hole, the anode is placed in the hole and driven against the reinforcing steel with a mallet and punch. The anode deforms against the steel, simultaneously making an electrical and mechanical connection. The remainder of the hole is then filled with a suitable grout material. The alternate version of the pellet has an attached lead wire. This version of the anode is used in situations of very shallow concrete cover (less than 38 mm) when there is not enough depth to place the anode on "top" of the reinforcing steel. These anodes are installed in a similar manner to the cylindrical anodes, with a two-hole method.

Applications

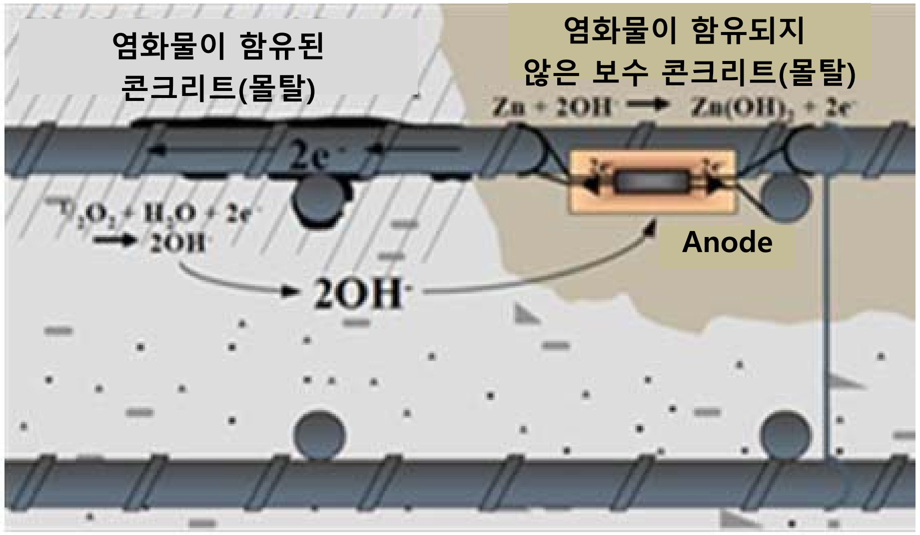
Repair and protection of concrete structures offers many unique challenges from a corrosion perspective. In particular the "Ring-Anode" effect, also called the "Halo" effect is a phenomenon that is frequently overlooked but is a common cause of premature patch-failure. The principles of chloride-induced corrosion are well understood, and corrosion is known to be an electrochemical reaction. Much like a battery, all corrosion cells have an anode and a cathode. During the corrosion process the anodic portion of steel is converted to iron oxide (rust). The ring-anode effect results in an increase in corrosion activity caused by the electrochemical incompatibility created between reinforcing steel within a patch area and the steel embedded within the surrounding

4

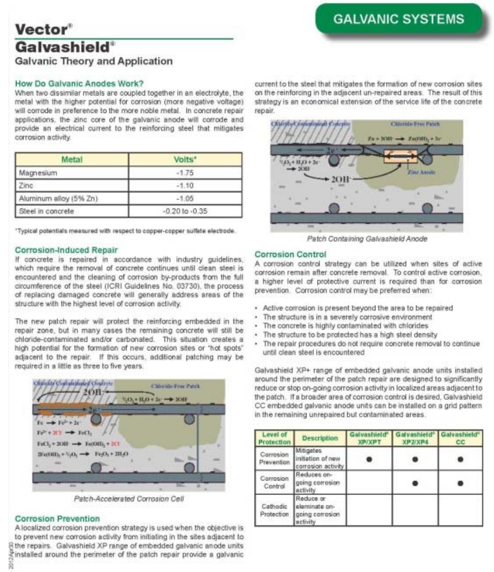
DAOR
DAOR E&C CO., LTD.

텐던 보수 : 희생양극(Anode)

- 두 개의 서로 다른 금속(희생양극 & 강연선)이 전해질(몰탈)에 함께 결합되면 부식 가능성이 더 큰(음전압) 금속(희생양극)이 그렇지 않은 금속(강연선)보다 우선적으로 부식



"How Do Galvanic Anodes Work?"



GALVANIC SYSTEMS

Vector®
Galvashield®
Galvanic Theory and Application

How Do Galvanic Anodes Work?
When two dissimilar metals are coupled together in an electrolyte, the metal with the higher potential for corrosion (more negative voltage) will corrode in preference to the more noble metal. In concrete repair applications, the zinc core of the galvanic anode will corrode and provide an electrical current to the reinforcing steel that mitigates corrosion activity.

Metal	Volts*
Magnesium	-1.75
Zinc	-1.10
Aluminum alloy (5% Zn)	-1.05
Steel in concrete	-0.20 to -0.35

*Typical potentials measured with respect to copper-copper sulfate electrode.

Corrosion-Induced Repair
If concrete is repaired in accordance with industry guidelines, which require the removal of concrete continues until clean steel is encountered and the cleaning of corrosion by-products from the full circumference of the steel (ICRI Guidelines No. 03730), the process of replacing damaged concrete will generally address areas of the structure with the highest level of corrosion activity.

The new patch repair will protect the reinforcing embedded in the repair zone, but in many cases the remaining concrete will still be chloride-contaminated and/or carbonated. This situation creates a high potential for the formation of new corrosion sites or "hot spots" adjacent to the repair. If this occurs, additional patching may be required in a little as three to five years.

Patch-Accelerated Corrosion Cell

Corrosion Prevention
A localized corrosion prevention strategy is used when the objective is to prevent new corrosion activity from initiating in the sites adjacent to the repairs. Galvashield XP range of embedded galvanic anode units installed around the perimeter of the patch repair provide a galvanic current to the steel that mitigates the formation of new corrosion sites on the reinforcing in the adjacent un-repaired areas. The result of this strategy is an economical extension of the service life of the concrete repair.

Patch Containing Galvashield Anode

Corrosion Control
A corrosion control strategy can be utilized when sites of active corrosion remain after concrete removal. To control active corrosion, a higher level of protective current is required than for corrosion prevention. Corrosion control may be preferred when:

- Active corrosion is present beyond the area to be repaired
- The structure is in a severely corrosive environment
- The concrete is highly contaminated with chlorides
- The structure to be protected has a high steel density
- The repair procedures do not require concrete removal to continue until clean steel is encountered

Galvashield XP+ range of embedded galvanic anode units installed around the perimeter of the patch repair are designed to significantly reduce or stop on-going corrosion activity in localized areas adjacent to the patch. If a broader area of corrosion control is desired, Galvashield CC embedded galvanic anode units can be installed on a grid pattern in the remaining unrepaired but contaminated areas.

Level of Protection	Description	Galvashield® XP/XPT	Galvashield® XP2/XP4	Galvashield® CC
Corrosion Prevention	Mitigates initiation of new corrosion activity	●	●	●
Corrosion Control	Reduces on-going corrosion activity		●	●
Cathodic Protection	Reduce or eleminate on-going corrosion activity			

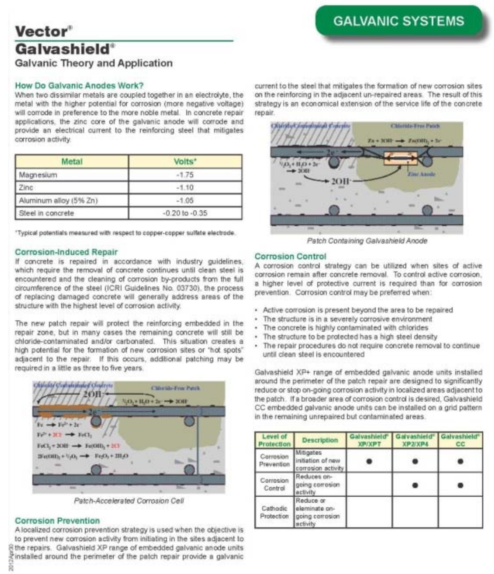
2012Apr30

DAOR E&C CO., LTD.

텐던 보수 : 희생양극(Anode)

- 희생양극으로 아연 코어를 설치하면 부식이 되면서 보강재의 부식을 완화시키는 전류를 공급

"How Do Galvanic Anodes Work?"



GALVANIC SYSTEMS

Vector®

Galvashield®

Galvanic Theory and Application

How Do Galvanic Anodes Work?

When two dissimilar metals are coupled together in an electrolyte, the metal with the higher potential for corrosion (more negative voltage) will corrode in preference to the more noble metal. In concrete repair applications, the zinc core of the galvanic anode will corrode and provide an electrical current to the reinforcing steel that mitigates corrosion activity.

Metal	Volts*
Magnesium	-1.75
Zinc	-1.10
Aluminum alloy (5% Zn)	-1.05
Steel in concrete	-0.20 to -0.35

*Typical potentials measured with respect to copper-copper sulfate electrode.

Corrosion-Induced Repair

If concrete is repaired in accordance with industry guidelines, which require the removal of concrete continues until clean steel is encountered and the cleaning of corrosion by-products from the full circumference of the steel (ICRI Guidelines No. 03730), the process of replacing damaged concrete will generally address areas of the structure with the highest level of corrosion activity.

The new patch repair will protect the reinforcing embedded in the repair zone, but in many cases the remaining concrete will still be chloride-contaminated and/or carbonated. This situation creates a high potential for the formation of new corrosion sites or "hot spots" adjacent to the repair. If this occurs, additional patching may be required in a little as three to five years.

Patch-Accelerated Corrosion Cell

Corrosion Prevention

A localized corrosion prevention strategy is used when the objective is to prevent new corrosion activity from initiating in the sites adjacent to the repairs. Galvashield XP range of embedded galvanic anode units installed around the perimeter of the patch repair provide a galvanic current to the steel that mitigates the formation of new corrosion sites on the reinforcing in the adjacent un-repaired areas. The result of this strategy is an economical extension of the service life of the concrete repair.

Patch Containing Galvashield Anode

Corrosion Control

A corrosion control strategy can be utilized when sites of active corrosion remain after concrete removal. To control active corrosion, a higher level of protective current is required than for corrosion prevention. Corrosion control may be preferred when:

- Active corrosion is present beyond the area to be repaired
- The structure is in a severely corrosive environment
- The concrete is highly contaminated with chlorides
- The structure to be protected has a high steel density
- The repair procedures do not require concrete removal to continue until clean steel is encountered

Galvashield XP+ range of embedded galvanic anode units installed around the perimeter of the patch repair are designed to significantly reduce or stop on-going corrosion activity in localized areas adjacent to the patch. If a broader area of corrosion control is desired, Galvashield CC embedded galvanic anode units can be installed on a grid pattern in the remaining unrepaired but contaminated areas.

Level of Protection	Description	Galvashield® XP/XPT	Galvashield® XP2/XP4	Galvashield® CC
Corrosion Prevention	Mitigates initiation of new corrosion activity	●	●	●
Corrosion Control	Reduces on-going corrosion activity		●	●
Cathodic Protection	Reduce or eleminate on-going corrosion activity			

DAOR
DAOR E&C CO., LTD.