BAB V
KESIMPULAN DAN SARAN

5.1. Kesimpulan

Dari hasil analisis data dan pembahasan yang telah dilakukan dapat ditarik suatu kesimpulan sebagai berikut:

1. Perbaikan dengan metode konvensional
   a. Biaya perbaikan dengan metode konvensional.
      Dari hasil analisis data menggunakan SNI 2002 dapat diketahui biaya perbaikan yang dibutuhkan untuk perbaikan dengan menggunakan metode konvensional yaitu sejumlah Rp 25.121.418,14.
   b. Waktu yang dibutuhkan untuk perbaikan dengan metode konvensional.
      Dari hasil analisis data menggunakan SNI 2002 dapat diketahui waktu pelaksanaan perbaikan yang dibutuhkan untuk perbaikan dengan menggunakan metode konvensional yaitu selama 21 hari.

2. Perbaikan dengan menggunakan chemical construction.
   a. Biaya perbaikan dengan menggunakan material chemical construction.
      Dari data lapangan yang didapat dari kontraktor pelaksana dapat diketahui biaya perbaikan yang dibutuhkan untuk perbaikan dengan
menggunakan material chemical construction yaitu sejumlah Rp 36.129.157.88.

b. Waktu perbaikan dengan menggunakan material chemical construction.

Dari data lapangan yang didapat dari kontraktor pelaksana dapat diketahui waktu pelaksanaan perbaikan yang dibutuhkan untuk perbaikan dengan menggunakan material chemical construction yaitu selama 9 hari.

Dari hasil perhitungan tersebut dapat dilihat bahwa dengan menggunakan material chemical construction waktu pekerjaan, dapat dipercepat hingga 162,5 % tetapi membutuhkan biaya yang lebih mahal sebanyak 15,38 % jika dibandingkan dengan metode konvensional.

5.2. Saran

Masalah manajemen waktu dan biaya dalam pelaksanaan suatu proyek, baik dalam proyek bangunan baru maupun dalam proyek perbaikan sangat penting untuk dipertahankan. Sehingga harus dipilih metode pelaksanaan perbaikan yang sesuai dengan keadaan lapangan dan keinginan owner.
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Triwiyono, A., Priyosulistyo Hrc., Handayani AW., Wikana, I., Pemakaian Tulangan Spiral untuk Perbaikan Kolom Beton yang Rusak Akibat Gempa, Jurusan Teknik Sipil Universitas Gadjah Mada
**Inbextra EP**

High compressive, tensile and flexural strengths
- Fast, convenient installation with early strength gain
- withstands a wide range of chemicals

**Description**

Inbextra EP is a range of epoxy resin based products designed for free-flow grouting of gaps from approximately 0.25 mm to 120 mm. Four grades of product are available:

- **Inbextra EP10** for grouting gaps ranging from 0.25 mm to 10 mm. It is an all-liquid system consisting of a base and hardener, and usually used as a non-mixable resin to seal cavities or cracks.
- **Inbextra EP40** for grouting gaps ranging from 10 mm to 40 mm.
- **Inbextra EP65** for grouting gaps ranging from 35 mm to 65 mm.
- **Inbextra EP120** is a low exotherm material which is particularly suitable where long working time is needed, for large gaps (up to 120 mm) or for grouting at high ambient temperatures (up to 50°C).

These products are all three component systems consisting of base resin, hardener and specially graded inert fillers.

**Virtues**

- Creep characteristics under sustained loading
- Insensitive to repetitive dynamic loads
- Shrink and hence ensures complete surface contact with adjacent surfaces

**Applications**

- High speed turbine and condenser grouting
- High speed turbine and condenser grouting
- Railway grouting
- Porcelain insulator grouting
- Dam grouting

**Suggested Uses**

- Concrete construction
- Railway construction
- Hydroelectric plant construction
- Miscellaneous construction

Inbextra EP is readily supported baseplate incorporating Pindal brand rail clips.
**Viscoelastic support**

Provides a comprehensive range of high performance,
viscoelastic support products all backed by BS 5750
certification. Foram offers a technical support package to
users and contractors as well as technical advice from staff
with a wealth of experience in the industry.

**Table: Typical results**

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>y (kg/m²)</td>
<td>1600</td>
<td>1550</td>
<td>2050</td>
<td>1550</td>
</tr>
<tr>
<td>flexural strength (Nm²/m²)</td>
<td>57</td>
<td>84</td>
<td>83</td>
<td>45</td>
</tr>
<tr>
<td>9 part 2 1983</td>
<td>60</td>
<td>80</td>
<td>97</td>
<td>93</td>
</tr>
<tr>
<td>9 part 3 1990</td>
<td>83</td>
<td>96</td>
<td>100</td>
<td>94</td>
</tr>
<tr>
<td>tensile strength (Nm²)</td>
<td>29</td>
<td>39</td>
<td>35</td>
<td>18</td>
</tr>
<tr>
<td>9 part 7 1980</td>
<td>51</td>
<td>40</td>
<td>29</td>
<td>34</td>
</tr>
<tr>
<td>adhesion (&lt;KN/m²)</td>
<td>13.3</td>
<td>13.3</td>
<td>12.3</td>
<td></td>
</tr>
<tr>
<td>9 part 6 1984</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Exotherm**

At eposy systems will develop a temperature rise on mixing.
Its extent will be a function of the volume to surface ratio, the
ambient temperature as well as the mass and thermal
conductivity of the surrounding materials. Contact Foram for
specific data on each product.

**Specification classes**

**Supplier specification**

All eposy resin grouting where shown on the drawings must
be carried out using the suitable grade of Cubix Epoxy EP product
manufactured by Foram and used in accordance with the
manufacturer’s data sheet.

**Performance specification**

All eposy resin grouting where shown on the drawings must
be carried out with a factory packed product. The hardened
gROUT must have a compressive strength which exceeds
80 N/mm² at 7 days, a tensile strength which exceeds
15 N/mm² at 7 days and a flexural strength which exceeds
20 N/mm² at 7 days.

The storage handling and placement of the grout will be in
strict accordance with the manufacturer’s instructions.

**Instructions for use**

**Preparation**

**Foundation surface**

All contact surfaces must be free from oil, grease, fat,
emulsions, mild acids and alkalis, fresh and sea water.
Foram’s Technical Department will provide guidance on
whether or not a treatment is necessary.

**Steel surfaces**

All steel surfaces should be shot blasted free of rust and
dirty mill scale. Cleared surfaces may be protected by the application
of Nipprim e.g. 0.5mm.

**Formwork**

The formwork should be constructed to be leakproof as
Cubix Epoxy EP products are free flowing grouts. Loss of grout
once the material is placed, but not hardened, will result in
incomplete filling of the gap.

For flow grout conditions it is essential to provide a
hydrostatic head of grout. To achieve this a leading hopper
system should be used.
onbextra EP

Cal on-plate shutter system

1. Filling hopper: For larger pours the grout may be hand packed into a removable hopper ( trough).

2. 20 mm thick plywood or Masonite.

3. 20 x 20 mm. Ventile ballast to substrate.

Alternative levelling devices:

Elastic strips

Max. 100 kg.

Double nuts

(not recommended)

Cleaning

All tools and equipment should be cleaned immediately after use with Fermco Solvent 102. Spillages should be absorbed with sawdust or sand and disposed of in accordance with local regulations.

Limitations

Temperature

During application

For all product, grouting may be carried out without special precautions at ambient temperatures from 5°C to 30°C. At temperatures above 31°C pot life will be shorter.

For EP120, at temperatures below 20°C the cure rate may be slow, but will go to completion provided the temperature remains above 5°C.

In service

The cured grouts, which are completely resistant to frost and sub-zero temperatures, are suitable for use up to 80°C.

Estimating

Supply

EP10: 5 litre pails containing base and hardener.

EP40, 65, 120: 8 litre pails containing base, hardener and filler.

Storage

All onbextra EP products have a shelf life of

12 months if kept in dry conditions at 5°C - 35°C.

* Note: See pumping head vs distance table

<table>
<thead>
<tr>
<th>°C</th>
<th>Gap thickness (mm)</th>
<th>Hydrostatic head (mm)</th>
<th>Maximum flow (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP10</td>
<td>Flow determined by gap thickness and pressure applied.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EP40</td>
<td>5 12 100 450</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EP60</td>
<td>20 12 100 900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EP120</td>
<td>5 35 100 2800</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 35 100 2800</td>
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<td></td>
</tr>
</tbody>
</table>

constructive solutions  page 3 of 4
Onbextra EP

Safety

- Solvent 102 is flammable. In the event of fire extinguish CO2 or foam.

Health and safety

- Onbextra EP: Contains resins which may cause sensitisation on contact. Avoid contact with skin and eyes and inhalation of vapours. Wear suitable protective clothing, gloves and eyewash. Barrier creams provide additional skin protection. In the event of skin contact occur, remove immediately with removing cream, followed by soap and water. Do not eat. In case of contact with eyes, rinse immediately with plenty of clean water and seek medical advice. If swallowed seek medical attention immediately - do not induce vomiting.

- Solvent 102: Flammable liquid. Vapour 33°C.

- Fire: Extinguish with dry powder, foam or carbon dioxide. Do not fight if it catches fire with water. Use suitable protective clothing, gloves and eye/face protection. Use only in well ventilated areas.

- Health: No known toxic effects. May cause eye irritation. Avoid prolonged skin contact.

- Environmental: No special precautions required.

- Disposal: Comply with local regulations.

- Transportation: UN No. 1592. No special precautions required.

- Packing instructions: UN No. 1592. No special precautions required.

- Labelling: Class 3. No special precautions required.

- Special recommendations: No special precautions required.

- Further information: For current information and data sheets, contact the manufacturer.

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- Further information: For current information and data sheets, contact the manufacturer.
Mile component free-flowing micro concrete

Highly fluid nature of Renderoc HFPremix obviates the need for compaction and vibration even where access to the pour zone is restricted in areas where reinforcement is present. The product is ideal for the reinstatement of structural sections of concrete as well as for many other locations where difficulties of access make hand or air-placed mortar impractical. It is suitable for use in excellent chloride and carbon dioxide resistance test. Renderoc HFPremix is alkaline in nature and will bond to steel reinforcement.

Ratings

Dual expansion system compensates for shrinkage in the plastic and hardener states.

Exceptional bond to concrete substrates without independent primer.

Suitable for placement by pumping or pouring techniques into restricted locations.

Self compacting nature eliminates honeycombing and displaces air without vibration.

High strength and low permeability provide maximum protection against carbon dioxide and chlorides.

Re-angled to overcome site-batched variation only in the binder of clean water is required. Contains no chloride admixtures.

CE Mark Compliance

Renderoc HFPremix conforms to the requirements of the Department of Transport Standard (DOT-2786, Clause 1 for the repair of Concrete Highway Structures).

Application

Renderoc HFPremix is supplied as a ready to use blend of powders which requires only the site addition of clean to produce a free-flowing, shrinkage compensated concrete suitable for large volume concrete repairs at thicknesses in excess of 50 mm. The material is 1 to Portland Cement sand aggregates and water in which a pre-determined expansion in both plastic and hardened states is a minimum water demand. The end product exhibits excellent thermal compatibility with standard and ordinary water repellent properties. Aggregate grading is designed to aid uniform mixing and eliminate segregation under pumping pressures. Water requirement ensures fast strength gain and term durability.

Technical Support

Offers a comprehensive range of high quality, high strength construction products. In addition, Foster a technical support service to specifiers, end-users and contractors, as well as on-site technical assistance in over the world.

Design Criteria

Renderoc HFPremix is designed for large volume repairs typically in excess of 500 mm thick although greater thickness may be achievable dependent on the configuration of the repair location and the volume of exposed reinforcing steel. Consult the local Foster office for further information.

Properties

The following results were obtained at a water/powder ratio of 0.13 and temperature 20°C.

Test Method | Typical Result
--- | ---
Flow Test (UK Dept. of Transport BD 27/88 Clause 4.5 [8]) | 750 mm within 10 sec
Setting Time (BS 4550), Initial Set | 6 hours, 30 mins @ 20°C, 9 hours @ 20°C
Compressive Strength (BS 1881 Pt 116 - restrained) | 30 N/mm² @ 3 days, 45 N/mm² @ 7 days, 60 N/mm² @ 28 days
Water absorption ISAT (BS 1881 Pt 1 - 1970), 10 mins | 0.0125 m³/m³ sec, 0.007 m³/m³ sec
Coefficient of thermal expansion | 10 to 12 X 10⁻⁶/°C
Modulus of elasticity (BS 1881 Pt 121 - 1983, cylinder cast under restraint and water cured) | 33 kN/mm² @ 28 days
Bond strength (BS 6319 slant shear substrate preformed, no bonding aid) | 66 N/mm² @ 28 days
Fines wet density | Approximately 2270 kg/m² dependent on actual consistency used

Specification Considerations

Steel reinforcement primer

The steel reinforcement primer shall be Nitril Prime Zinc-rich, a single component zinc-rich epoxy resin. The primer shall be an active type capable of avoiding the generation of insipient modes in the immediately adjacent regions. It shall be fully compatible with the Renderoc system of concrete repairs.

Fluid Micro-Concrete Repair System

The fluid repair system (micro-concrete) shall be Renderoc HFPremix a single component, cement-based blend of powders which on the addition of clean water shall be permitted. The micro-concrete shall exhibit a 3-day compressive strength not less than 30 N/mm² and a 28 day compressive strength of 50 N/mm² (at 20°C), the coefficient of thermal expansion shall be within the range of 10 to 20 X 10⁻⁶/°C.
Operation

In the repair area, the steel must be free from scale and rust. Steel priming is necessary for this process. Any corrosion has occurred due to the presence of moisture, the steel should be high-pressure washed with water immediately after blast cleaning to remove any loose products from pores and imperfections within the steel.

Forcing steel priming

One full coat of Potaprim Zincharil and allow to dry overnight. If any doubt exists about having worn an unbroken coating, a second application should be made before continuing.

Stratifying

Primed areas prior to placing, the prepared concrete rates should be saturated by the prepared mixture with clean water. Immediately prior to the application of Rendocer HFpremixture, any excess water should be removed.

Note

It should be ensured that Rendocer HFpremixture is applied properly and mixed. A forced-action mixer is essential. If in a suitable sized drum using an approved spiral in a slow speed (300/500rpm) heavy-duty drill is used. Free fall mixes must not be used. Mixing of part should never be attempted.
ication or substrate conditions, consult the local Fosroc

imading

<table>
<thead>
<tr>
<th>diver HF/ premix</th>
<th>30 kg bag</th>
</tr>
</thead>
<tbody>
<tr>
<td>prime Zinorich</td>
<td>1 litre &amp; 5 litre tins</td>
</tr>
<tr>
<td>cure P</td>
<td>200 litre drums</td>
</tr>
<tr>
<td>cure 90 Clear</td>
<td>25 &amp; 200 litre drums</td>
</tr>
</tbody>
</table>

Usage & Yield

<table>
<thead>
<tr>
<th>diver HF/ premix</th>
<th>Approximately 14.5 litres / 30 kg bag</th>
</tr>
</thead>
<tbody>
<tr>
<td>prime Zinorich</td>
<td>7.4 m² / litre</td>
</tr>
<tr>
<td>cure P</td>
<td>5 m² / litre</td>
</tr>
<tr>
<td>cure 90 Clear</td>
<td>4 to 5 m² / litre</td>
</tr>
</tbody>
</table>

rs:
coverages figures for liquid products are theoretical to wastage factors and the variety and nature of base substrates, practical coverage figures will be less.

LAGE

Life

reduced have a shelf life of 6 months if kept in a dry in the original, unopened bags or vials.

age Conditions

in dry conditions in the original, unopened bags or vials, if stored at high temperatures and/or high humidity the shelf life may be reduced to 3 or 6 months.

CATIONS

h and safety

diver HF/ premix contains cement powders which, when exposed to the skin, during use, avoid inhalation of the dust, contact with the skin or eyes. Wear suitable protective equipment: eye protection and respiratory protective gear.

use of barrier creams to provide additional skin barrier is also advised. In case of contact with the skin, with plenty of clean water, then cleanse thoroughly with soap and water.

contact with eyes, rinse immediately with plenty of water and seek medical advice. If swallowed, seek medical attention immediately, do not induce vomiting.

Fire

Rendervc HF/ premix, Nitobond EP and Concure P are not flammables.

Nitoprime Zinorich and Concure 90 Clear are inflammable. Keep away from sources of ignition. No smoking. In the event of fire, extinguish with CO2 or foam. Do not use a water jet.
Nitobond EC

two-part epoxy bonding agent

Uses

dhesive compound is a specially formulated epoxy

pul adhesive for anchoring, bonding prefabricated

ements such as bridge segments.

Vantages

Excellent adhesive

Fast cure

Chemical resistance

Easy to use

rescription

hesive compound is an epoxy resin-bonded product

n special fine filler. The components differ in colour

allow visual assessment of mixing.

roperties

colour: Grey

ted density (kg/m³): 1800

t life (mins): 60 at 25°C

5 at 30°C

ressive Strength (N/mm²)

1 day: 60

3 days: 70

7 days: 80

inside Strength (N/mm²)

5 0319 part 7, 1985

7 days: 22

ural Strength (N/mm²)

5 0319 part 5, 1990

7 days: 50

2nd Strength-Shear (N/mm²)

5 0319 part 4, 1990

7 days: 40

Failure of concentration)

Instruction For Use

Surface Preparation

Concrete should be mechanically sound, dry and free

from oil or grease, laitance and dust. A dry grit blast

urface is recommended for optimum adhesion.

Bar should be deformed. This will ensure good bond

between bar and adhesive compound.

Bar should be degreased and any mill scale or flaky rust

removed.

Mixing

The contents of hardener should be added to the base

and mixed for three minutes (minimum) with a

paddle and slow speed heavy duty drill, ensuring the

side are scraped down. A uniform grey colour should be

obtained.

Application

Precast Element

The mix adhesive should be applied at the required

thickness to both laying surfaces with a serrated trowel

or other suitable spreader.

Anchoring

The mixed grout should be poured or pumped steadily

into the prepared anchor holes. The anchor bar should

then be pressed into the hole to the required depth.

Slight agitation of the bar will greatly assist in achieving

a complete bond.

The bar should be left undisturbed in the required

position until the adhesive compound hardened fully.
bond EC

Table

<table>
<thead>
<tr>
<th>Depth</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>0.25 (=200/800)</td>
</tr>
<tr>
<td>400</td>
<td>0.5</td>
</tr>
<tr>
<td>200</td>
<td>0.57</td>
</tr>
<tr>
<td>100</td>
<td>0.65</td>
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<tr>
<td>500</td>
<td>0.8</td>
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<tr>
<td>1000</td>
<td>1.0</td>
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<tr>
<td>1500</td>
<td>1.33</td>
</tr>
<tr>
<td>2000</td>
<td>2.00</td>
</tr>
</tbody>
</table>

Packing

5 kg pack containing hardener and based.

Storage

At least 12 months if stored below 35 °C in unopened containers.

Precautions

Fire

Forsooc Solvent 102 is flammable. In the event of fire extinguish CO₂ or foam.

Health and Safety

Adhesive Compound: Contains resins which may cause sensitisation by skin contact. Avoid contact with skin and eyes and inhalation of vapour.

Wear suitable protective clothing, goggles, and eyewash protection. Barrier creams provide additional skin protection. Supplied accidental skin contact occurs, remove immediately with a moist removing cream, followed by soap and water. Do not use solvents. In case of contact with eyes, rinse immediately with plenty of clean water and seek medical advice. If swallowed seek medical attention immediately, do not induce vomiting.

Forsooc Solvent 102: Flammable Liquid Flash Point 33°C

Keep away from sources of ignition - no smoking, wear suitable protective clothing, goggles and eyes, face protection. Use only in well-ventilated areas.

Additional Information

Adhesive compound is part of a wide range of repair mortars, sealing components and protective coating products specially designed and manufactured by Forsooc for the construction industry.

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