ANALYSIS CAUSES DAMAGE AND PREVENTION OF CONCRETE

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Abstract. In the process of construction and post-construction, various problems can often be encountered, with one of them being damage to the concrete which can cause weakening of the concrete structure or damage to the concrete structure. Therefore, the need to prevent such damage by analyzing the causes of damage can be minimized. This research was carried out in collaboration with the contractor, where the first step taken was direct observation and interviews with the implementing contractor. By aiming to get primary data and secondary data so that data conclusions can be made and knowing the causes of damage to concrete structures in the construction phase can then provide advice on preventing damage to concrete structures that can be done. Based on the results of the study, it was found that the potential causes of damaging the concrete structure in the construction phase were problems with the height of the fall of casting, errors in construction, execution, vibrators, and errors in the installation of begisting.

Keywords: Concrete, construction process, cause of damage

1. Preliminary
Concrete is one of the supporting in construction. Concrete has a vital function especially for the structure of a building. The use of concrete in a building, shop, residential house is different from the use of concrete for roads. [1] This is the thing that causes concrete as a building material to remain the main choice of planners in designing and planning civil engineering buildings [2] " When the times progress along with the growth of the human population, infrastructure development is very intensively carried out, starting from the construction of bridges, buildings, residences and various other construction constructions " [3] Construction in the field during the construction and post-construction processes we often encounter various problems, one of which is in concrete construction, for example, columns, beams, plates, and concrete walls. Due to many factors found in the field. [4] Related to the concept of sustainable development, mitigating the damage to concrete structures is done to reduce the impact of damage to the environment.[5]

2. Research objectives and benefits
Identification analysis of concrete damage aims to find out the common causes of damage to concrete structures, as well as provide information on prevention methods to avoid damage to concrete structures. This agreed analysis is useful to provide information to relevant parties in the field necessary to take action before damage to the concrete occurs.

3. **Theoretical basis**

3.1 Damage to concrete structures

Seeing the nature of the concrete that is prone to cracking must be identified starting from the beginning of the concrete construction. [6] Concrete is a new breakthrough that has a very broad function in the world of construction. [7] Based on its compressive strength, the quality of concrete is divided into 3 types, namely ordinary quality concrete, high quality concrete, and very high quality concrete is the most appropriate choice for making high-rise buildings. [8]

Damage to the concrete is grouped into 3 categories:

- "Crack is damage to concrete in the form of relatively long, narrow lines. While cracks that are shallow and interconnected on the surface of the plate are called crazing. And cracks that are in or wide are called random cracks" [9]
- Voids with wide and deep hollow structures. "The factor that gives rise to voids is the poor compaction of vibrators, the distance between formworks and reinforcements that are too narrow so that the mortar is not able to fill the cavity between the aggregates well"
- "Scaling / Erosion shallow peels on the surface, which can be caused by repeated expositions to freezing and thawing resulting in the surface becoming exfoliated, this condition is called scaling"

3.2 Type of concrete structure repair material

In the advanced era like now there is a large amount of material that can be used to repair concrete structures that are damaged, including:

- Epoxy (resin based material)
  "Epoxy is generally made on the basis of epoxy resins which include injection, castor mortar and paste that can be applied by hand. Epoxy mortar is divided into 2, namely: hardener and filler" [10]
- Bentonite
  "Rock powder usually taken from volcanic dust with clay mineral content with high sodium Bentonite" [13]
- Silicones
  "Used as a repair material for the problem of water vapor through walls, with 2 ways of making, namely dissolving solid silicone in solution" [14]

4. **Research methodology**

4.1 Identification analysis is carried out with several stages of research:
1. Collection of literature data as a sample of any factors that cause damage to concrete structures.
2. Observation and data collection carried out by conducting direct surveys on construction projects.
3. After observing and collecting data, the data is processed and analyzed for conclusions. [16]

4.2 Types of data used consist of 2 types, namely:
   1. Secondary data is supporting data sourced from literature, or reference journals
   2. Primary data obtained directly from observations of construction projects in the field. Data collection for this study was carried out by collecting data directly in the field.

5. Results and discussion
5.1 Summary of Concrete Damage
The results of the discussion of the identification analysis of this study were obtained by examining as many as 20 projects that suffered concrete damage. Then the data is compiled to make tables to cover the whole.

Table 5.1 Causes of damage to concrete

| No. | Type of Structure | Type of damage | Causes of Damage                  |
|-----|-------------------|----------------|-----------------------------------|
| 1   | Plate             | Cracked        | Design failure                    |
|     |                   |                | Error removing formwork           |
|     |                   |                | Additional load                   |
|     |                   |                | Curring                           |
|     |                   | Voids          | Vibrator                          |
|     |                   | Honeycomb      | Vibrator                          |
| 2   | Shear wall        | Voids          | Vibrator                          |
| 3   | Basement wall     | Cracked        | Repair error                      |
| 4   | Beam              | Cracked        | Design failure                    |
|     |                   |                | Additional load                   |
|     |                   | Voids          | Repair error                      |
|     |                   |                | Formwork installation error       |
|     |                   |                | Vibrator                          |
| 5   | Column            | Honeycomb      | High fall casting                 |
|     |                   |                | Vibrator                          |
|     |                   | Cracked        | Additional load                   |
|     |                   | Voids          | Vibrator                          |

Source: Data processed

Based on the type of structure as many as 8 projects (35%) there was damage to the plate, in the beam as many as 5 projects (26%), in the column as many as 4 projects (24%), on the
shear wall there were 2 projects that were damaged (9%) and the last damage to the basement wall is only found in 1 project (6%). The percentage of damage to the structure can be seen in the picture

![Graph of Types of Damage to Concrete Structures](image1)

**Figure 5.1** Graph of Types of Damage to Concrete Structures

Based on the types of damage there are 2 types of damage namely crack and porous (Voids and Honeycomb). For cracks there are 10 construction projects of 50% while porous (Voids and Honeycomb) are in 10 construction projects of 50%.

![Graph of Total Amount of Structural Damage Types](image2)

**Figure 5.2** Graph of Total Amount of Structural Damage Types

5.2 Cause Damage to concrete structures

The highest concrete casting error in 1 project is 4.15%, the formwork release error on 1 project is 4.15%, the error in formwork installation on 1 project is 4.15%, error correction is in 4 projects of 16.66%, vibrator error in 8 projects amounting to 33.32%, curring errors in 2 projects amounted to 12.2%, failure in design on 2 projects amounted to 8.20% and the last error in loading was on 5 projects by 20.83%. then the graphical percentage obtained as follows:
Table 5.1 Table of Type of Damage Cases

| PROJECT CASE |  |
|--------------|---|
| High fall casting | 4.1 0% |
| Release of formwork | 4.1 0% |
| Formwork installation | 4.1 0% |
| Repair error | 15.6 0% |
| Vibrator | 32.10% |
| Curring | 11% |
| Design failure | 8.20% |
| Additional load | 20.8 0% |

Source: data processed

5.3 Prevention of damage to concrete structures
S Etela h construction stands there are 3 important activities that must be waged, namely maintenance, repair and retrofitting. Prevention of damage to concrete structures should be carried out as follows: Prevention measures that can be taken include:

- Prevention when making a vibrator error by maximizing compaction done. When composing a vibrator, it is better to follow the SNI 03-3976 (1995) procedure.
- Prevention of errors in curring concrete by following applicable procedures on SNI 03-3976 (1995)

6. Conclusions and recommendations
6.1 Conclusions
From the results of the analysis of identification of damage to the concrete structure it can be concluded that the potential causes of damaging the concrete structure in the construction phase are the problems of the height of the fall of casting, maintenance errors, vibrators, and incorrect installation of begisting.

Causes that have the potential to damage the concrete structure in post-construction on the problem of releasing formwork, curring factors, and problems regarding additional loads. As well as the results of this study, the damage that occurs most often occurs in the construction phase due to problems implementing compaction using a vibrator.

6.2 Suggestions
Suggestions from the analysis of identification carried out should take precautions before damage to the concrete structure occurs, here are the procedures for dealing with damage to concrete, namely:

1. Prevention of high fall casting is carried out 3-4 ft. Drop the mixture vertically. Casting is done layer by layer.
2. Prevention of the vibrator process by maximizing compaction is done by following the correct procedures on SNI 03-3976 (1995)
3. In the prevention of pembesian by conducting reinforcement checks installed before begisting. The design of retention and installation of tofu concrete must also be considered with regard to SNI
4. Prevention is done before releasing plate formwork by getting approval from the contractor with the results of concrete compressive strength test
5. Prevention on curing can be prevented by following the applicable provisions of SNI 03-3976 (1995)
6. Preventing excessive burdens by holding the first discussion with the planning consultant.
7. Prevention in design errors by ensuring that the design is in accordance with the planning drawing.

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