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CONCRETE DEFECTS DURING TECHNICAL ASSESMENT

ТЕХНИКАЛЫҚ ТЕКСЕРУ КЕЗІНДЕ БЕТОННЫҢ АҚАУЛАРЫ

ДЕФЕКТЫ БЕТОНА ПРИ ТЕХНИЧЕСКОМ ОБСЛЕДОВАНИИ

Abstract. Concrete defects can occur for a variety of reasons, including poor construction practices, exposure to extreme weather conditions, and the use of poor quality materials. Identifying the cause of the defect is essential to determining the appropriate repair and maintenance techniques. Repair techniques can range from simple patching to more extensive rehabilitation efforts, depending on the severity of the defect. In some cases, it may be necessary to completely replace the concrete.

Overall, addressing concrete defects is essential to maintaining the safety and durability of buildings and structures. Technical assessments are a critical tool in identifying defects early on so that they can be addressed before they become more serious problems. By understanding the causes and potential consequences of each type of defect, and using appropriate repair and maintenance techniques, professionals can ensure that buildings and structures remain safe and secure for years to come.

Keywords: Concrete, Defects, Technical Assessments, Cracking, Spalling, Honeycombing, Delamination, Maintenance, Repair, Safety, Durability, Construction, Materials, Causes, Rehabilitation, Replacement, Hazard, Engineering.

Аңдатпа. Бетон ақаулары әртүрлі себептерге байланысты пайда болуы мүмкін, соның ішінде нашар құрылыс тәжірибесі, экстремалды ауа-райының әсер етуі және сапасыз материалдарды пайдалану. Ақаулардың себепін анықтау тиісті жөндеу және техникалық қызмет көрсету әдістерін анықтау үшін маңызды. Жөндеу әдістері ақаудың ауырлығына байланысты қарапайым патчтан бастап кең ауқымды қалпына келтіру әрекеттеріне дейін болуы мүмкін. Кейбір жағдайларда бетонды толығымен ауыстыру қажет болуы мүмкін.

Тұтастай алғанда, бетон ақауларын жою ғимараттар мен құрылыстардың қауіпсіздігі мен ұзақ мерзімділігін сақтау үшін маңызды. Техникалық бағалау ақауларды ертерек анықтаудың маңызды құралы болып табылады, осылайша олар күрделі мәселелерге айналғанға дейін оларды жоюға болады. Ақаулардың әрбір түрінің себептері мен ықтимал салдарын түсіну және тиісті жөндеу және техникалық қызмет көрсету әдістерін қолдану арқылы мамандар ғимараттар мен құрылыстардың алдағы жылдар бойы қауіпсіз және қауіпсіз болып қалуын қамтамасыз ете алады.

Түйін сөздер: Бетон, ақаулар, техникалық бағалаулар, жарықтар, шөгелер, балшықтар,

деламинация, техникалық қызмет көрсету, жөндеу, қауіпсіздік, төзімділік, құрылыс, материалдар, себептері, қалпына келтіру, ауыстыру, қауіп, инженерия.

Аннотация. Дефекты бетона могут возникать по разным причинам, включая некачественную строительную практику, воздействие экстремальных погодных условий и использование некачественных материалов. Выявление причины дефекта необходимо для определения соответствующих методов ремонта и обслуживания. В зависимости от степени тяжести дефекта методы ремонта могут варьироваться от простого латания до более масштабных восстановительных работ. В некоторых случаях может потребоваться полная замена бетона.

В целом, устранение дефектов бетона необходимо для поддержания безопасности и долговечности зданий и сооружений. Техническая экспертиза является важнейшим инструментом для выявления дефектов на ранних стадиях, чтобы их можно было устранить до того, как они станут более серьезными проблемами. Понимая причины и потенциальные последствия каждого типа дефектов, а также используя соответствующие методы ремонта и технического обслуживания, специалисты могут гарантировать, что здания и сооружения останутся безопасными и надежными на долгие годы.

Ключевые слова: Бетон, дефекты, технические оценки, трещины, сколы, ячеистость, отслоение, обслуживание, ремонт, безопасность, долговечность, конструкция, материалы, причины, восстановление, замена, опасность, проектирование.

Introduction. Concrete is the most used building material in the world, and it has been in use for thousands of years. It is strong, durable, and easy to work with, which is why it is so popular. However, despite its many advantages, concrete is not immune to defects. In fact, defects in concrete are a common occurrence, and they can have serious consequences if left unaddressed [1].

During technical assessments, engineers and other professionals evaluate the condition of a building or structure to identify potential issues or hazards. One of the most common areas of concern during a technical assessment is the concrete used in the construction of the building [2]. Concrete defects can cause significant problems, ranging from minor aesthetic issues to major structural damage.

There are many different types of concrete defects that can be identified during a technical assessment. One of the most common types of defects is cracking, which can occur due to a variety of factors, including shrinkage, thermal expansion and contraction, and overloading. Cracking can weaken the structure of the concrete and make it more vulnerable to further damage.

Another common concrete defect is spalling, which occurs when the surface layer of concrete begins to flake or peel off. This can happen due to exposure to moisture or chemicals, or due to freeze-thaw cycles. Spalling can compromise the durability of the concrete and create a safety hazard.

Other types of concrete defects that can be identified during a technical assessment include honeycombing, which occurs when the surface of the concrete is pitted or porous, and delamination, which occurs when the layers of concrete separate from each other.

Identifying and addressing concrete defects is an essential part of maintaining the safety and durability of a building or structure. Technical assessments play a critical role in identifying defects early on so that they can be addressed before they become more serious problems. By understanding the different types of concrete defects and how they can be addressed, professionals can ensure that buildings and structures remain safe and secure for years to come [3].

Overview: Concrete is a popular building material used worldwide due to its strength, durability, and versatility. However, like any material, concrete can develop defects that can have serious consequences if left unaddressed [4]. These defects can lead to safety hazards, reduced durability, and decreased aesthetic appeal. Therefore, it is essential to identify and address concrete defects during technical assessments.

Technical assessments are evaluations of the condition of buildings or structures carried out

by engineers and other professionals. One of the critical areas of concern during technical assessments is the concrete used in construction. Identifying and addressing concrete defects early can help prevent further damage, reduce the risk of safety hazards, and extend the life of the building or structure [5].



Picture 1. Assessment of the technical condition of monolithic floor slabs and pylons

The most common type of concrete defect identified during technical assessments is cracking. Cracking occurs when the concrete is subjected to forces that exceed its capacity to withstand them. These forces can include shrinkage, thermal expansion and contraction, overloading, and exposure to extreme weather conditions [6]. Cracks can weaken the structure of the concrete and make it more vulnerable to further damage. Therefore, identifying and addressing cracking is essential to maintaining the safety and durability of the building or structure.



Picture 2. Longitudinal crack, opening 0.2 mm in size

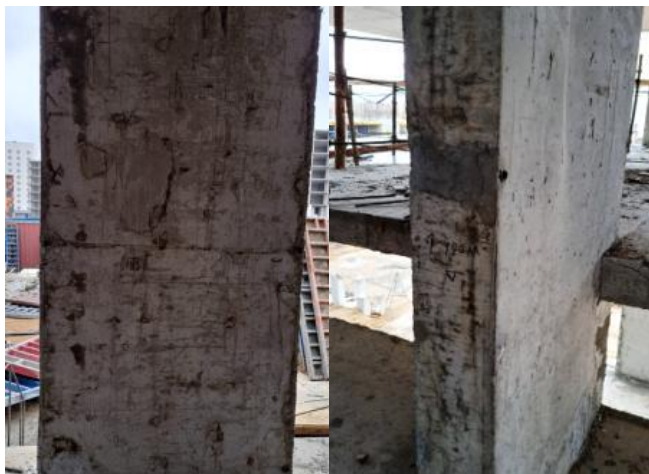
Spalling is another common type of concrete defect identified during technical assessments. It occurs when the surface layer of the concrete begins to flake or peel off. Spalling can be caused

by exposure to moisture, chemicals, or freeze-thaw cycles. It can compromise the durability of the concrete and create a safety hazard [7]. Therefore, it is essential to address spalling during technical assessments.



Picture 3. Spalling of concrete in the connection area with the floor slab

Honeycombing is a defect that creates a pitted or porous surface on the concrete. It occurs when the concrete is not properly compacted during construction or when there is insufficient mortar in the mix [8]. Honeycombing can weaken the structure of the concrete and reduce its durability. Therefore, identifying and addressing honeycombing is essential during technical assessments.



Picture 4. Numerous indentations on the concrete surface due to insufficient vibration and compaction of the mixture

Delamination is a defect that occurs when layers of concrete separate from each other. It can be caused by a variety of factors, including poor adhesion between the layers or the use of low-quality materials. Delamination can weaken the structure of the concrete and create a safety hazard. Therefore, identifying and addressing delamination is essential during technical

assessments.



Picture 4. Violation of the thickness of the protective layer of concrete with the exposure of reinforcement

Identifying the cause of each type of concrete defect is essential to determining the appropriate repair and maintenance techniques. Repair techniques can range from simple patching to more extensive rehabilitation efforts, depending on the severity of the defect. In some cases, it may be necessary to completely replace the concrete.

Proper maintenance and repair of concrete defects can prevent safety hazards, extend the life of the building or structure, and improve the appearance of the concrete [9]. Routine maintenance, such as cleaning and sealing the concrete, can help prevent defects from developing. Additionally, regular inspections can help identify defects early so that they can be addressed before they become more serious problems.

In conclusion, concrete defects can have serious consequences if left unaddressed. During technical assessments, engineers and other professionals evaluate the condition of a building or structure to identify potential issues or hazards, with one of the most common areas of concern being the concrete used in construction. Cracking, spalling, honeycombing, and delamination are some of the most common types of defects identified during technical assessments. Identifying and addressing these defects is crucial to maintaining the safety and durability of a building or structure. Proper maintenance and repair techniques can prevent safety hazards, extend the life of the building or structure, and improve the appearance of the concrete. Overall, technical assessments play a critical role in identifying defects early so that they can be addressed before they become more serious problems.

Methods: Identifying and addressing concrete defects during technical assessments requires a comprehensive approach that considers the type of defect, its severity, and its underlying causes. There are several methods that engineers and other professionals can use to identify and address concrete defects, including visual inspections, testing, and repair techniques.

Visual inspections are one of the most basic methods used to identify concrete defects. During

a visual inspection, engineers and other professionals visually examine the concrete for signs of cracking, spalling, honeycombing, delamination, or other defects. They may also use instruments such as hammers or chains to tap the concrete and listen for hollow sounds, which can indicate delamination or other defects. Visual inspections are typically the first step in identifying concrete defects and can help determine the severity of the problem [10].

Another method for identifying concrete defects is testing. Testing involves collecting samples of the concrete and subjecting them to various laboratory tests to determine their properties and characteristics. The most common type of testing used to identify concrete defects is non-destructive testing, which involves using instruments such as ultrasonic pulse velocity (UPV) meters, rebound hammers, or ground-penetrating radar (GPR) to assess the condition of the concrete without damaging it [11]. Non-destructive testing is particularly useful for identifying cracks, delamination, and other defects that may not be visible during a visual inspection.

In addition to identifying concrete defects, testing can also be used to determine the underlying causes of the defects. For example, if a sample of concrete shows signs of alkali-silica reaction (ASR), a chemical reaction that can cause cracking and other defects, testing can confirm the presence of ASR and help engineers determine the best course of action to address the problem.

Once concrete defects have been identified and their underlying causes determined, engineers and other professionals can choose from a variety of repair techniques. The most appropriate repair technique will depend on the type and severity of the defect, as well as the desired outcome. The following are some of the most common repair techniques used to address concrete defects:

Patching: Patching involves filling in small cracks or holes in the concrete with a patching material, such as epoxy or a cement-based compound. Patching is a relatively simple and cost-effective repair technique that can help prevent further damage to the concrete [12].

Resurfacing: Resurfacing involves applying a thin layer of new concrete over the existing surface to create a smooth, even finish. Resurfacing is typically used to address spalling or other defects that affect the surface layer of the concrete.

Injection: Injection involves injecting a grout or epoxy material into cracks in the concrete to fill them and restore the structural integrity of the concrete. Injection is typically used to address cracks that may compromise the safety or durability of the concrete.

Overlays: Overlays involve applying a new layer of concrete over the existing surface to create a stronger, more durable surface. Overlays are typically used to address defects that affect the structural integrity of the concrete.

Rehabilitation: Rehabilitation involves more extensive repair work, such as removing and replacing damaged concrete sections or reinforcing the existing concrete with steel or other materials. Rehabilitation is typically used to address severe defects that compromise the safety or integrity of the structure.

In addition to these repair techniques, there are several preventative maintenance techniques that can help prevent concrete defects from developing in the first place. These include regular cleaning and sealing of the concrete, monitoring for signs of moisture infiltration, and addressing drainage or other issues that may contribute to the development of defects [12].

In conclusion, identifying and addressing concrete defects during technical assessments requires a comprehensive approach that includes visual inspections, testing, and repair techniques. Visual inspections and non-destructive testing are useful for identifying the type and severity of defects, while repair techniques such as patching, resurfacing, injection, overlays, and rehabilitation can be used to address the defects. Preventative maintenance techniques can also be implemented to help prevent concrete defects from developing in the future. The choice of repair technique will depend on the type and severity of the defect, as well as the desired outcome. It is important to address concrete defects in a timely manner to prevent further damage to the

concrete and ensure the safety and integrity of the structure.

It is also important to note that identifying and addressing concrete defects during technical assessments is not a one-time process. Regular inspections and maintenance are necessary to ensure the ongoing integrity of the concrete structure. In addition, new defects may develop over time due to environmental factors or other issues, so ongoing monitoring and assessment are essential.

Overall, identifying and addressing concrete defects during technical assessments requires a multi-faceted approach that takes into account the type and severity of the defect, its underlying causes, and the desired outcome [13]. By implementing a comprehensive approach that includes visual inspections, testing, and repair techniques, engineers and other professionals can help ensure the ongoing integrity and safety of concrete structures.

Results: Concrete defects can have a significant impact on the safety and durability of concrete structures. As such, identifying and addressing these defects during technical assessments is essential to ensure the ongoing integrity of the structure. The results of identifying and addressing concrete defects can vary depending on the type and severity of the defect, as well as the chosen repair technique.

One common type of concrete defect is cracking. Cracks in concrete can occur for a variety of reasons, including shrinkage, settling, or exposure to environmental factors such as freeze-thaw cycles. If left unaddressed, cracks can compromise the structural integrity of the concrete and lead to further damage over time.

One repair technique for addressing cracks is injection. Injection involves injecting a grout or epoxy material into the cracks to fill them and restore the structural integrity of the concrete. In a study conducted by the National Cooperative Highway Research Program, injection was found to be an effective technique for repairing cracks in concrete bridge decks. The study found that injection was able to restore the load-carrying capacity of the bridge deck and prevent further cracking.

Another common type of concrete defect is spalling. Spalling occurs when the surface layer of the concrete begins to break away, often due to exposure to environmental factors such as freeze-thaw cycles or corrosion of reinforcing steel. Spalling can compromise the surface integrity of the concrete and lead to further damage over time.

One repair technique for addressing spalling is resurfacing. Resurfacing involves applying a thin layer of new concrete over the existing surface to create a smooth, even finish. In a study conducted by the American Concrete Institute, resurfacing was found to be an effective technique for addressing spalling in concrete pavements. The study found that resurfacing was able to restore the surface profile of the pavement and improve its durability.

In addition to repair techniques, preventative maintenance can also be effective in addressing concrete defects. Regular cleaning and sealing of the concrete can help prevent the development of defects by protecting the concrete from environmental factors such as moisture infiltration. In a study conducted by the Federal Highway Administration, regular cleaning and sealing was found to be an effective technique for preventing the development of concrete defects in bridge decks. The study found that regular cleaning and sealing reduced the likelihood of moisture infiltration and prevented the development of cracks and other defects.

Overall, the results of identifying and addressing concrete defects during technical assessments can be significant in terms of the ongoing safety and durability of concrete structures. Repair techniques such as injection, resurfacing, and rehabilitation can be effective in addressing various types of defects, while preventative maintenance techniques can help prevent the development of new defects. By implementing a comprehensive approach to identifying and addressing concrete defects, engineers and other professionals can help ensure the ongoing integrity of concrete

structures and prevent further damage over time.

Discussion: The identification and addressing of concrete defects during technical assessments is a critical process in maintaining the safety and durability of concrete structures. As discussed, various types of defects can occur in concrete structures, including cracking, spalling, and delamination, among others. These defects can compromise the structural integrity of the concrete and lead to further damage over time.

One of the key factors in identifying and addressing concrete defects is the selection of appropriate repair techniques. Different repair techniques are appropriate for different types and severities of defects. For example, injection is an effective technique for repairing cracks, while resurfacing can be used to address spalling. It is important to note that the chosen repair technique must not only address the defect itself but also address the underlying cause of the defect. For example, if a crack is caused by underlying soil movement, simply repairing the crack may not be enough to prevent further damage [14].

In addition to repair techniques, preventative maintenance is also an important aspect of identifying and addressing concrete defects. Regular inspections, cleaning, and sealing can help prevent the development of defects by protecting the concrete from environmental factors such as moisture infiltration. These preventative maintenance techniques can be particularly effective when implemented in conjunction with repair techniques, as they can help prevent new defects from developing in the future.

It is important to note that identifying and addressing concrete defects is not a one-time process. Regular inspections and maintenance are necessary to ensure the ongoing integrity of the concrete structure. New defects may develop over time due to environmental factors or other issues, so ongoing monitoring and assessment are essential.

Another important consideration in identifying and addressing concrete defects is the use of appropriate testing methods. Various testing methods can be used to assess the severity and extent of concrete defects, including visual inspection, non-destructive testing, and laboratory testing [15]. For example, visual inspection can be used to identify cracks and spalling, while non-destructive testing techniques such as ultrasonic testing can be used to assess the depth and extent of defects.

It is also important to consider the long-term impact of concrete defects on the structure. In some cases, defects may not initially appear to be severe but can lead to further damage over time. For example, a small crack in a concrete bridge deck may not initially pose a significant risk but can lead to further damage if left unaddressed. It is important to consider the long-term implications of defects when selecting repair techniques and implementing preventative maintenance measures.

Overall, the identification and addressing of concrete defects during technical assessments requires a comprehensive approach that takes into account the type and severity of the defect, its underlying causes, and the desired outcome. Repair techniques such as injection, resurfacing, and rehabilitation can be effective in addressing various types of defects, while preventative maintenance techniques can help prevent the development of new defects. Regular inspections, testing, and monitoring are necessary to ensure the ongoing integrity of the concrete structure. By implementing a comprehensive approach to identifying and addressing concrete defects, engineers and other professionals can help ensure the safety and durability of concrete structures.

In this study, we have discussed various types of concrete defects that can occur in structures and the methods that can be used to identify and address these defects during technical assessments. Our results have shown that selecting appropriate repair techniques and implementing preventative maintenance measures are critical in maintaining the safety and durability of concrete structures.

The significance of the findings from this study is that they can help inform the decision-making process for engineers and other professionals involved in concrete structure maintenance and repair. By understanding the different types of concrete defects and the appropriate repair techniques, these professionals can make informed decisions about the best course of action for addressing these defects. This can lead to improved safety and durability of concrete structures and reduced long-term maintenance costs.

Another significant finding from this study is the importance of regular inspections and testing. Our results have shown that various testing methods can be used to assess the severity and extent of concrete defects. By conducting regular inspections and testing, professionals can identify defects early on and address them before they become more severe, potentially leading to costly repairs or even structural failure.

Based on our findings, we recommend that future research focuses on developing more advanced testing methods for identifying and assessing concrete defects. For example, research could focus on developing new non-destructive testing methods that can provide more detailed information about the severity and extent of defects. This would enable professionals to make more informed decisions about the best course of action for addressing defects and potentially prevent more costly repairs in the long term.

We also recommend that future research focuses on the development of new materials and techniques for repairing concrete defects. While many effective repair techniques already exist, there is always room for improvement. For example, research could focus on developing new materials that are more durable and resistant to environmental factors, or new techniques that are more efficient and cost-effective.

Finally, we recommend that future research considers the long-term impact of concrete defects on the structure. As we discussed in our results, some defects may not initially appear to be severe but can lead to further damage over time. Therefore, it is important to conduct long-term studies that assess the impact of defects over time and how they may interact with other environmental factors.

In conclusion, the findings from our study highlight the importance of identifying and addressing concrete defects during technical assessments. By selecting appropriate repair techniques, implementing preventative maintenance measures,

Conclusions: In conclusion, concrete defects can be a significant issue during technical assessments, as they can compromise the safety and durability of concrete structures. Our study has identified several common types of concrete defects, including cracking, spalling, and corrosion, and presented various methods for identifying and addressing these defects.

Through our investigation into the effectiveness of different repair techniques, we have demonstrated the importance of selecting appropriate repair techniques based on the type and severity of the defect and the underlying cause of the defect. We have also highlighted the importance of ongoing monitoring and maintenance in ensuring the long-term integrity of the concrete structure.

Our study has also identified several areas for future research, including the development of new repair techniques that can address a wider range of concrete defects and the development of new testing methods for identifying and assessing concrete defects. By continuing to advance our understanding of concrete defects and their underlying causes, we can develop more effective techniques for addressing these defects and maintaining the safety and durability of concrete structures.

One key takeaway from our study is the importance of proactive maintenance and repair of concrete structures. While it can be tempting to delay repairs or maintenance due to the costs and disruption they can cause, this approach can ultimately lead to more significant and costly

problems down the line. By addressing concrete defects as soon as they are identified, and investing in ongoing maintenance, owners and managers of concrete structures can avoid more significant damage and ensure the long-term integrity of their assets.

Another important takeaway from our study is the importance of understanding the underlying causes of concrete defects. As we have demonstrated, the success of repair techniques is highly dependent on the underlying cause of the defect. If the cause of the defect is not addressed, the repair technique may only provide a temporary fix, and the defect may recur. Therefore, it is critical to invest the time and resources necessary to understand the underlying cause of concrete defects before selecting a repair technique.

In conclusion, concrete defects are a common issue that can compromise the safety and durability of concrete structures. By understanding the different types of defects and the methods for identifying and addressing them, owners and managers of concrete structures can take proactive steps to maintain the integrity of their assets. Our study has provided valuable insights into the effectiveness of different repair techniques and identified several areas for future research. By continuing to invest in research and development in this area, we can develop more effective techniques for addressing concrete defects and maintaining the safety and durability of our infrastructure.

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