



CASE STUDY



CONCRETE REPAIRS

Concrete structures can weaken over time due to various reasons such as age, wear and tear, environmental factors, and design flaws. As a result, strengthening becomes necessary to ensure the safety of the building and the people who use it. Additionally, structural changes in the building and upgrades may also require strengthening. By reinforcing concrete structures, building owners and managers can protect their investments and ensure the safety and durability of their properties.

Concrete structures may require strengthening for several reasons. These include structural damage caused by environmental factors, physical damage, or seismic activity, the need to increase load capacity, design deficiencies, aging infrastructure, and retrofitting for new uses.

PROJECT DETAILS

Concrete column jacketing with steel reinforcement and micro concrete, cutting of defective slab and reconstruct with required steel reinforcement.

Client : Ministry of Energy and Minerals

Consultant : MACE International LLC

Contractor : Euro Postech International

Applicator : Abu Anas LLC

CONCRETE REPAIRS

Strengthening may be necessary to repair damage, accommodate new equipment, meet current building code requirements, extend the lifespan of the structure, and ensure it can handle new loads and stresses.

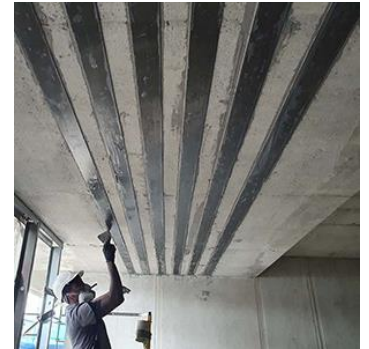


CONCRETE REPAIR METHODS FOR STRENGTHENING.

Concrete jacketing : This involves the application of a new layer of concrete to the surface of an existing concrete structure. The new concrete layer is typically reinforced with steel bars or mesh to provide additional strength and stiffness. Concrete jacketing is commonly used to repair and strengthen columns, walls, and other structural members that have been damaged or weakened by weathering, corrosion, or other factors. It can also be used to increase the load-bearing capacity of existing structures.



Carbon fibre strengthening : This involves the use of carbon fibre composites to reinforce existing concrete structures. Carbon fibre is a lightweight and high-strength material that can be applied to the surface of the structure in the form of sheets or strips. The carbon fibre is bonded to the surface of the concrete using epoxy adhesive, and it provides additional strength and stiffness to the structure. Carbon fibre strengthening is commonly used to repair and strengthen bridges, columns, and other structural members.



Concrete slab cutting : This involves the use of diamond blades or other cutting tools to create openings or remove sections of existing concrete slabs. Concrete slab cutting is commonly used to create openings for new pipes, ducts, or electrical conduits, or to remove damaged or deteriorated sections of concrete. Concrete slab cutting can be done using various types of equipment, such as hand-held saws, walk-behind saws, and diamond wire saws. The choice of equipment depends on the specific project requirements, the thickness and hardness of the concrete, and other factors.



Concrete stitching : This involves the use of metal or fibre staples to repair cracks or fractures in existing concrete structures. The staples are inserted into the concrete on either side of the crack, and then grouted in place to create a strong bond. Concrete stitching is commonly used to repair walls, slabs, and other structural members that have been damaged by settlement or other factors. It can also be used to increase the load-bearing capacity of existing structures.

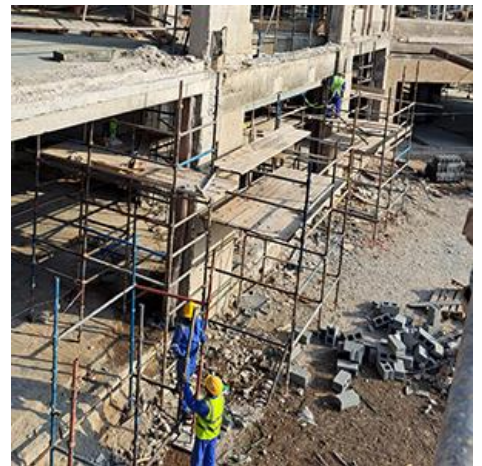




DESIGN PHASE

The design phase of a concrete strengthening project is critical in ensuring that the repair is effective and long-lasting. A structural engineer is typically responsible for this phase, which involves assessing the existing structure, developing design concepts, analyzing and selecting the most suitable design, creating detailed design drawings and specifications, and obtaining the necessary permits and approvals. The structural engineer's expertise is essential in developing a solution that meets project requirements, complies with codes and standards, and addresses identified issues with the existing structure.

At Al Khuwair Muscat, we have successfully completed a significant concrete jacketing project for the Ministry of Energy & Minerals. The project, led by the Structural Design Consultants, Amjaad Consultancy, project management consultants MACE and the contractors, Euro Postech International, encompassed jacketing work for a total of 66 columns on the ground floor and 41 columns on the first floor. In addition, some flawed slabs had to be cut and recast with new reinforcements anchored. We executed the column jacketing work with extra reinforcements and micro concrete pour and the slab with steel and ready mix concrete in accordance with the instructions of the structural designers.



SAFETY

Safety is of paramount importance in any concrete strengthening job. Workers must be trained and equipped with proper safety gear to prevent accidents and injuries. It is important to establish safety protocols and procedures that are adhered to at all times. This helps minimize risks and ensure that the job is carried out safely.

At the site, strict adherence to safety protocols was ensured. All workers were given tool box talks, training on scaffolding use, and instructions on handling construction chemicals. Safety inductions were conducted for any new personnel arriving at the site to ensure that they were aware of the safety procedures.



Conducted regular safety trainings at construction site.



SAFETY TRAINING AT SITE



PRODUCT AND TOOLS FOR THE JOB

Product selection is crucial for a concrete strengthening job as it determines the long-term durability and stability of the structure. The right product should be selected based on specific job requirements, such as the type of structure, extent of damage, and expected loads. Choosing the wrong product can result in additional damage and expensive repairs.

In addition to product selection, using the appropriate tools and equipment is equally important. Professional mixers for micro concrete, drills for anchoring rebars, and specialized slab and wall cutters are essential for a successful concrete repair and strengthening job. The use of proper tools and equipment can ensure that the job is done efficiently and effectively.



Heavy duty slab cutter





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TOOLS AND PRODUCTS USED



CONSTRUCTION CHEMICALS USED IN THE PROJECT.

With reference to the structural requirements by the structural designer the following products were proposed and approved for usage.

Supplier of construction chemicals for the project were Master Builder Solutions.

Micro Concrete – **MasterEmaco S466**
Rebar Anchoring – **Masterflow 932 AN**
Bonding Agent - **MasterEmaco P210**

A well-known building material supplier provided the steel and scaffolding material specified for the project.



For professional application of construction chemicals in Oman
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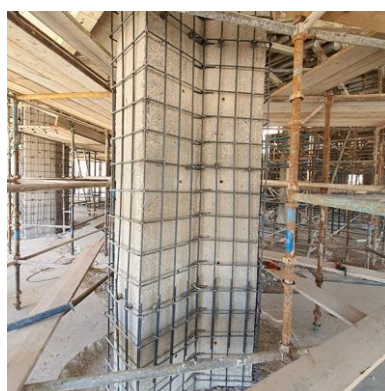
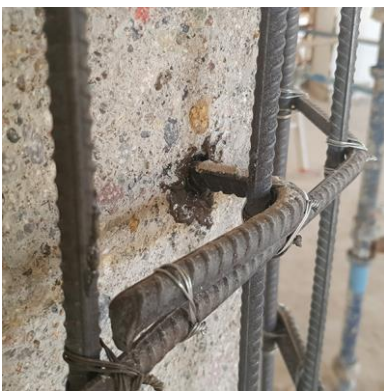
info@abuanas.om



SURFACE PREPARATION



FIXING OF STEEL REINFORCEMENT



In the concrete jacketing process, steel fixing with chemical anchors is crucial for reinforcing and strengthening existing concrete structures. Chemical anchors create a strong and durable bond between the steel reinforcement and the existing concrete.



STRENGTHENING WITH MICRO CONCRETE

When constructing a column jacket using micro concrete, a shutter needs to be created around the column to hold the micro concrete in place while it sets. The shutter is a temporary formwork that is designed to fit tightly around the column, creating a cavity that can be filled with micro concrete.

The shutter is typically constructed from plywood sheets that are cut to the correct size and shape for the column. The plywood sheets are then held in place using supports or ties to create a tight seal around the column. The shutter needs to be securely fastened to the column to prevent any leakage or movement of the micro concrete during the pouring and setting process.

The shutter needs to be carefully designed and constructed to ensure that it can withstand the pressure of the micro concrete as it is poured and compacted. The shutter needs to be strong enough to hold the weight of the micro concrete, but also flexible enough to allow for any slight variations in the shape of the column.



MIXING AND POURING MICRO CONCRETE

Micro concrete is a high-strength, low-shrinkage concrete mix that is specifically designed for repair and strengthening applications. It contains a combination of fine aggregates, cement, and additives that improve its bonding properties, durability, and workability.

The surface of the existing column is cleaned, and a bonding agent is applied to ensure good adhesion between the old and new concrete. Then, the micro concrete is mixed according to the manufacturer's instructions and poured into the space between the column and the jacket. The process involved creating a core cut or a hole in the concrete slab above the column using a core drill. The size and location of the core cut was carefully selected to provide access to the column without compromising the structural integrity of the slab.



MIXING AND PLACING OF MICRO CONCRETE



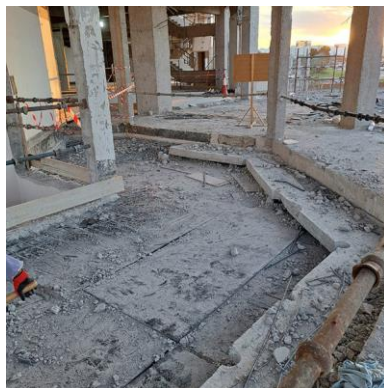
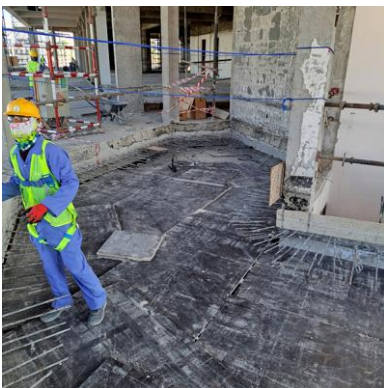
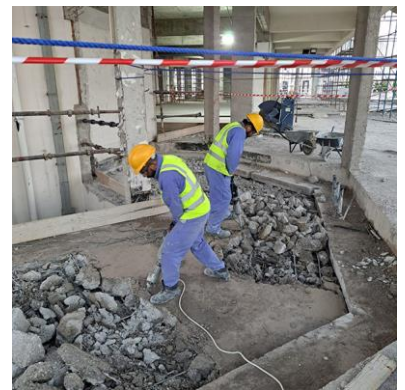
Once the core cut is made, the debris is removed the micro concrete is mixed according to the manufacturer's instructions and poured through the core cut into the space between the column and the slab. Pouring micro concrete through a core cut in the slab above the column can be a more effective way of strengthening and repairing deteriorating concrete columns in certain situations.





CUTTING OF CONCRETE SLAB

There are several reasons why a defective concrete slab may need to be cut and replaced. When a concrete slab becomes defective due to issues such as cracking, shifting, or water damage, it can pose safety hazards, compromise the structural integrity of a building. Repairing such issues can be costly, and in some cases, replacing the entire slab may be more cost-effective in the long run. Thus, cutting out the defective slab and reconstructing a new one is often the best solution to ensure safety, maintain structural integrity, and improve the value of the property. Before cutting the marked slab using a slab cutter, the area underneath the slab needs to be supported with foam work. The concrete of the slab was subsequently broken up and disposed.





CASTING OF CONCRETE SLAB



Casting a concrete slab involves a series of steps, including site preparation, formwork, reinforcement, pouring the concrete, finishing, and curing. The site must first be cleared and levelled, with the formwork set up to the required shape and dimensions. Steel reinforcement is added to the formwork, and the concrete is poured, compacted to achieve a level surface. The slab is then cured by keeping it moist and at a specific temperature for several days to allow it to set and harden properly. Attention to detail and careful planning are essential to ensure that the slab is strong, durable, and in level.





TESTING PROCESS CONDUCTED AT SITE

Pullout testing: This involves applying a tensile force to the rebar using a hydraulic jack and measuring the force required to pull the rebar out of the concrete. This test is used to determine the bond strength between the rebar and the concrete.

The manufacturer Master Builders Solutions conducted regular pull of test among other inspections carried out at site.



Compressive Strength Test

Temperature Test

Slump Test

IMPORTANCE OF CONCRETE TESTING AT SITE

Testing during the concrete pouring process is critical to ensure the quality, strength, durability, safety, and compliance of the finished product. Testing verifies that the correct materials have been used, the mix proportions are correct, and the concrete has the desired properties. Compliance with local building codes and project specification is also crucial for ensuring that the finished project meets the required standards.





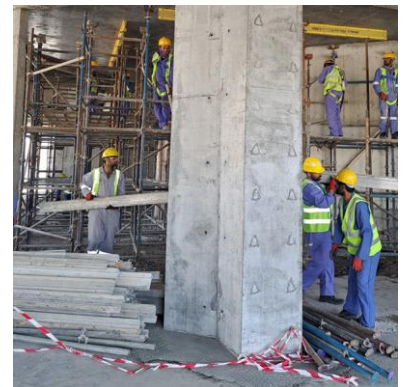
SUPPORT FORM THE MANUFACTURER

We would like to express our sincere gratitude to Master Builder Solutions for their exceptional support during this concrete strengthening project. Their top-quality construction chemicals played a vital role in the success of the project, and all were extremely satisfied with the performance of their products. Additionally, the sales, technical, and management teams at Master Builder Solutions provided us with timely and efficient support, ensuring that we received the necessary materials on time and in the right quantities. Their expertise and guidance proved invaluable throughout the project, and we couldn't have completed it on time without their support. We thank Master Builder Solutions, for their commitment to excellence and for being a reliable partner in our project's success.



PROJECT COMPLETION

We completed the project in accordance with the requirements of the consultants and clients, while ensuring that safety and quality were our main priorities throughout the project. Our team worked tirelessly to ensure that every aspect of the project was executed to the highest standards, from the initial planning and design stages through to the final stages of strengthening and testing. We are delighted to report that the project was completed on time and within budget, and that the strengthened concrete structure has met or exceeded all required performance specifications. We are confident that the strengthened structure will continue to provide reliable and safe service for many years to come. We thank our team for the high-quality workmanship and attention to detail they provided for this project.





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TRAINED AND CERTIFIED APPLICATOR

A trained and certified applicator is crucial for carrying out concrete jacketing, strengthening, carbon fiber installation, and repairs. Without proper training, an applicator may not have the necessary expertise to properly install or repair these materials, which could lead to further damage or structural issues. A trained and certified applicator will have a better understanding of the materials and techniques involved in the repair process, allowing them to identify and address any potential issues or challenges that may arise during the project. This can help ensure that the repair work is completed efficiently and effectively, reducing the risk of further damage or structural issues down the line. Abu Anas LLC is such an applicator with the expertise and equipment's required to carry out a successful concrete restoration work.

In addition, working with a trained and certified applicator can provide peace of mind to property owners. They can be confident that the repair work is being carried out by a qualified professional who has undergone rigorous training and certification processes. This can help to ensure the safety and integrity of the repaired structure, providing long-term value and protection for the property. Contact Abu Anas LLC for your next concrete repair / restoration works in Oman at info@abuanas.om or call 00968 91145302.



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+968 91145302



info@abuanas.om