STAR
COOLING TOWERS

Inspection and Maintenance of Round Concrete Mechanical Cooling Towers Draft

COOLING TOWER TECHNOLOGY EXPERTS SINCE 1951

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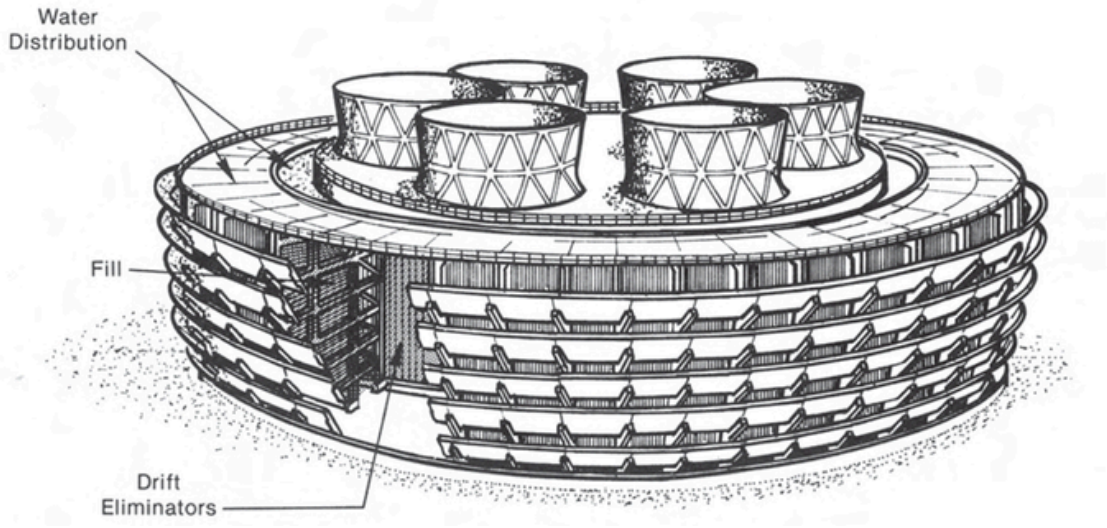
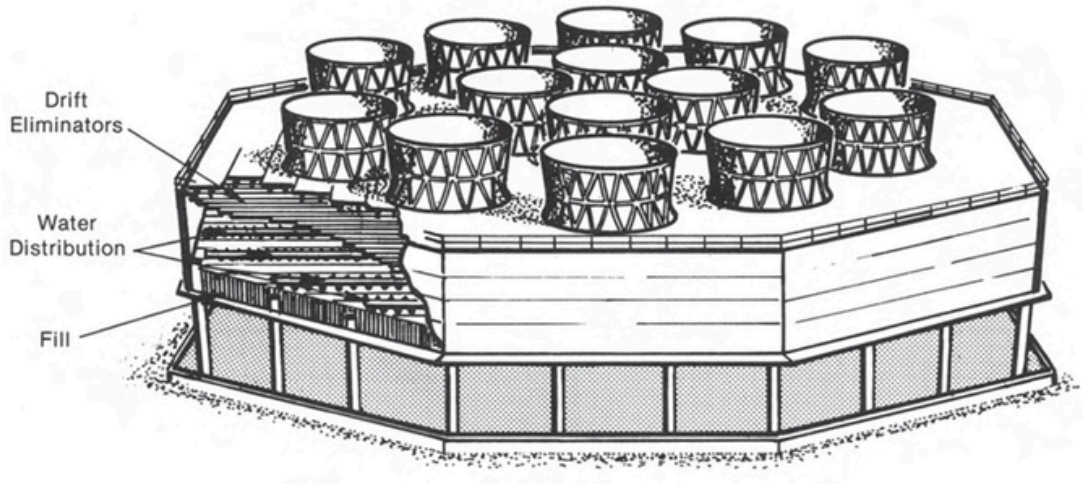
ROUND - OCTAGON MECHANICAL DRAFT COOLING TOWER DESIGNS



ROUND CROSSFLOW MECHANICAL DRAFT TOWER



OCTAGON COUNTERFLOW MECHANICAL DRAFT TOWER

ROUTINE INSPECTION AND REPAIR OF THE INTERNAL COMPONENTS OF A COOLING TOWER, ESPECIALLY A MECHANICAL DRAFT COOLING TOWER, IS CRUCIAL FOR ENSURING OPTIMAL PERFORMANCE AND LONGEVITY.

KEY COMPONENTS FOR INSPECTION

- Fill Media
- Drift Eliminators
- Nozzles and Distribution System
- Mechanical Equipment
- Fan Stacks
- Precast Concrete Support Beams
- Cold Water Basin
- Internal Walkways
- External Stairways

Pre-Inspection Preparation

Safety Briefing: Conduct a safety briefing for all inspection team members with input from the site point of contact, highlighting specific hazards related to the cooling tower environment.

Shutdown Procedures: Ensure the cooling tower is safely shut down according to the plant operations permit issuer and site-specific procedures to prevent any operational hazards during the inspection.

Fall Protection: Full body harness with twin retractable lanyards for 100% fall protection secured to OSHA-approved anchorages.

Access Setup: Arrange for safe access to the film fill, drift eliminator, and distribution areas, using ladders, scaffolding, or other safe access equipment as required.

FILL/PACKING

Visual and Physical Inspection

General Condition: Begin with a general assessment of the film fill's condition. Look for any obvious signs of wear, tear, or structural damage.
Material Integrity: Check the fill material for signs of degradation such as brittleness, warping, or chemical damage. Uniformity and Alignment: Ensure that the fill sheets are properly aligned and uniformly spaced. Misalignment can cause uneven water distribution.
Uniformity and Alignment: Ensure that the fill sheets are properly aligned and uniformly spaced. Misalignment can cause uneven water distribution.
Clogging and Fouling: Inspect for clogging of the fill material due to debris, minerals, biological growth, or other foreign materials that could impede water flow.
Scale Build-Up: Assess the extent of scaling on the fill, which can reduce cooling efficiency by inhibiting heat transfer.
Mechanical Integrity: Inspect for any mechanical damage from maintenance activities or environmental conditions.
Documentation: Inspection Report: Document all findings in a detailed report with photographs and descriptions of any anomalies or damages. Include recommendations for corrective actions. Suggest repairs or replacement of damaged fill sections as necessary.

STAR
COOLING TOWERS

DRIFT ELIMINATORS

Visual and Physical Inspection

General Condition: Check the overall condition of the drift eliminators for signs of wear or damage. Look for any visible deformations, cracks, or dislocations.

Material Integrity: Assess the materials for signs of degradation such as corrosion, UV damage, brittleness, or biological growth.

Alignment and Positioning: Ensure that the drift eliminators are correctly aligned and securely positioned within their frames. Misalignment can reduce the effectiveness and increase drift loss.

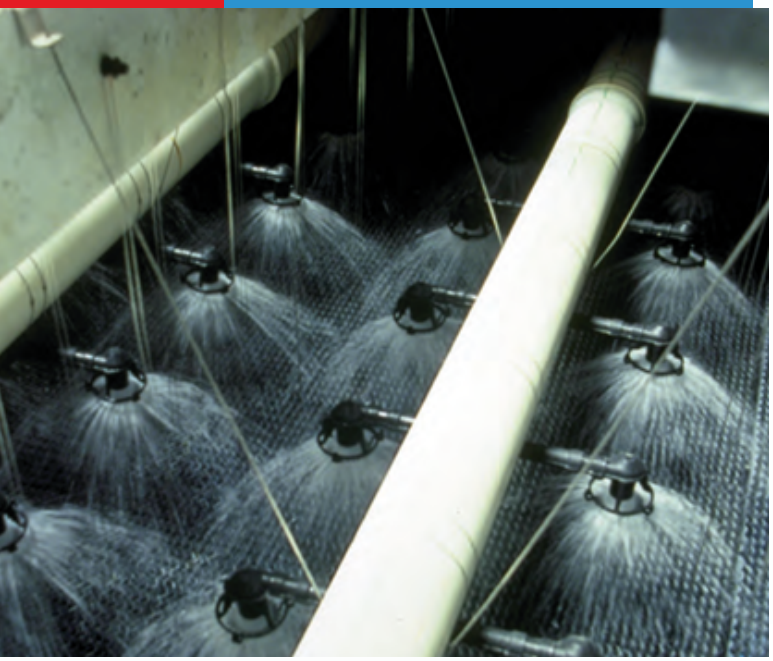
Blockage and Clogging: Inspect for any blockages caused by debris, mineral deposits, or biological growth, which can impede airflow and reduce efficiency.

Cleaning and Maintenance

Cleaning Procedures: Based on the type of contamination found (e.g., algae, mineral scaling), determine the appropriate cleaning methods. This could involve gentle washing with water or the use of specific cleaning agents.

Repair or Replace: Recommend repairs or replacements for damaged or severely degraded drift eliminators to ensure optimal performance.

Documentation: Inspection Report: Document all findings, including the condition of the drift eliminators, any issues noted, and recommended actions. Use photographs to illustrate specific issues. Suggest repairs or replacement of damaged drift eliminator sections as necessary.



DISTRIBUTION SYSTEM

Inspecting the water distribution system of a cooling tower is essential to ensure that it operates efficiently and effectively. The water distribution system's primary function is to distribute water evenly across the heat transfer surface, which is crucial for optimal cooling performance. Below is a structured guideline for the inspection of a cooling tower water distribution system:

General Condition: Start with a visual check of the overall condition of the water distribution system, including nozzles, pipes, and troughs.
Nozzles: Inspect for any blockages, wear, or damage. Nozzles are prone to clogging from minerals or debris and may require cleaning or replacement.
Piping and Troughs: Look for signs of leakage, corrosion, or misalignment in the pipes and troughs that distribute water over the fill.
Detailed Assessment: Uniformity of Water Flow: Check that water is being distributed evenly across the fill area. Uneven distribution can lead to dry spots and reduce the efficiency of the cooling process.
Debris and Scaling: Inspect for the accumulation of debris or scaling within the distribution system, which can impede water flow and distribution.

CLEANING AND MAINTENANCE

Cleaning Procedures: Based on the findings, clean the nozzles, pipes, and troughs using appropriate methods. This may include mechanical cleaning for mineral deposits and chemical cleaning for biological growth.
Repair or Replacement: Address any damage or wear by repairing or replacing parts of the water distribution system as necessary.
Documentation: Inspection Report: Compile a comprehensive report detailing the condition of the water distribution system, any issues identified, and actions taken or recommended.

FAN STACKS

Visual and Physical Inspection
General Condition: Begin with a general assessment of each fan stack's condition.
Surface Condition: Inspect the exterior and interior surfaces for signs of damage, such as cracks, delamination, discoloration, or corrosion.
Fasteners and Segments: Check the condition of bolts, nuts, and other fasteners for tightness and corrosion. Ensure all fan stack segments are secure and free from gaps.
Fiberglass Integrity: Look for signs of fiberglass degradation, such as fiber exposure, blistering, or resin erosion. Bonding and Adhesion: Check the bonding and adhesion of the fiberglass material at joints and seams.
Documentation: Document all findings in a detailed report with photographs and descriptions of any anomalies or damages. Include recommendations for corrective actions. Suggest repairs or replacement of each fan stack as necessary.

FAN ASSEMBLIES

Visual and Physical Inspection
General Condition: Begin with a general assessment of each fan's condition.
Fan Blades: Check for cracks, chips, or any signs of wear and tear. Ensure blades are securely attached and free from accumulations.
Mounting Hardware: Ensure all bolts, and fasteners are tight and secure. Look for signs of wear or corrosion.
Blade Pitch: Verify the blade pitch is correctly set according to manufacturer specifications.
Fan Blade Tracking: Verify each fan blade is tracking according to manufacturer specifications.
Documentation: Document all findings in a detailed report with photographs and descriptions of any anomalies or damages. Include recommendations for corrective actions. Suggest repairs or replacement of each fan assembly as necessary.

GEAR REDUCERS

Visual and Physical Inspection

General Condition: Begin with a general assessment of each gear reducer's condition.

Exterior Condition: Check the exterior of the gear reducer for any signs of damage, such as cracks, dents, or corrosion.

Oil Leaks: Inspect for oil leaks around seals, gaskets, and drain plugs. Look for oil stains or puddles underneath the unit.

Fasteners: Ensure all bolts, screws, and fasteners are secure and free from corrosion or damage.

Cooling Fins and Surfaces: Ensure cooling fins and surfaces are clean and free from debris that could hinder heat dissipation.

Oil Level: Check the oil level using a sight glass or dipstick. Ensure it is within the recommended range.

Oil Quality: Inspect the oil for clarity and contamination. Look for discoloration, foaming, or the presence of particles.

Oil Change Interval: Verify that the oil has been changed according to the manufacturer's recommended interval. If due, perform an oil change using the specified type and grade of oil.

Documentation: Document all findings in a detailed report with photographs and descriptions of any anomalies or damages. Include recommendations for corrective actions. Suggest repairs or replacement of each gear reducer as necessary.

FAN MOTORS

Visual and Physical Inspection

General Condition: Begin with a general assessment of each fan motor's condition. Motor Housing: Inspect the motor housing for any signs of damage, such as cracks, dents, or corrosion. Ensure the housing is clean and free from debris.

Cooling Fins and Vents: Ensure cooling fins and vents are clean and free from obstructions to allow proper ventilation.

Mounting Hardware: Verify that all mounting bolts and fasteners are secure and in good condition. Look for signs of wear or corrosion.

Bearings: Check the motor bearings for wear, noise, or vibration signs. Rotate the motor shaft manually to ensure it turns smoothly without resistance.

Lubrication Points: Identify all lubrication points as specified by the manufacturer. Lubricant Levels: As needed, check and replenish lubricant levels in bearings and other components.

Lubricant Quality: Ensure the lubricant is clean and free of contaminants.

Documentation: Inspection Report: Document all findings in a detailed report with photographs and descriptions of any anomalies or damages. Include recommendations for corrective actions. Suggest repairs or replacement of each fan motor as necessary.

DRIVE SHAFTS

Visual and Physical Inspection

General Condition: Begin with a general assessment of each drive shaft's condition.

Drive Shaft Condition: Inspect the drive shaft for any signs of wear, corrosion, cracks, or deformation.

Couplings and Keyways: Check the couplings and keyways for wear, alignment, and secure attachment. Ensure that all bolts and fasteners are tight and in good condition.

Shaft Surface: Look for any signs of pitting, scoring, or other surface damage that might affect performance.

Alignment: Use alignment tools to check for misalignment between the drive shaft and connected components (e.g., motor and gearbox). Misalignment can cause excessive vibration and wear.

Axial and Radial Play: Check for excessive axial or radial play in the drive shaft, which could indicate worn bearings or other issues.

Documentation: Inspection Report: Document all findings in a detailed report with photographs and descriptions of any anomalies or damages. Include recommendations for corrective actions. Suggest repairs or replacement of each drive shaft as necessary.

MECHANICAL SUPPORTS

Visual and Physical Inspection

General Condition: Begin with a general assessment of each unitized steel mechanical support condition. Look for any signs of excessive corrosion, the condition of fasteners and welds, and the motor and gear reducer mounting hardware.

Surface Condition: Check for signs of corrosion, rust, pitting, or other surface defects.

Welds: Inspect welds for cracks.

Deformation: Look for any signs of warping, bending, or other structural deformations.

Fastener Inspection: Ensure all bolts, nuts, and other fasteners are of the correct grade, properly tightened, and free from defects.

Documentation: Inspection Report: Document all findings in a detailed report with photographs and descriptions of any anomalies or damages. Include recommendations for corrective actions. Suggest repairs or replacement of the mechanical supports as necessary.

Precast Horizontal Support Structure

General Condition: Perform a general visual inspection of all accessible structures to assess the overall condition of the support structure. Look for any signs of immediate distress or obvious.

Surface Condition: Check for cracks, spalling, delamination, or any signs of surface degradation. Note the size, location, and pattern of these defects as they can indicate underlying issues.

External Stairway and Access Doors:

General Condition: Visual assessment of the stairway and access door. Inspect stair treads, risers, and handrails. Examine the door frame, hinges, and locking mechanisms. Check for deteriorated door seals or gaskets, which could compromise the environmental control within the tower.

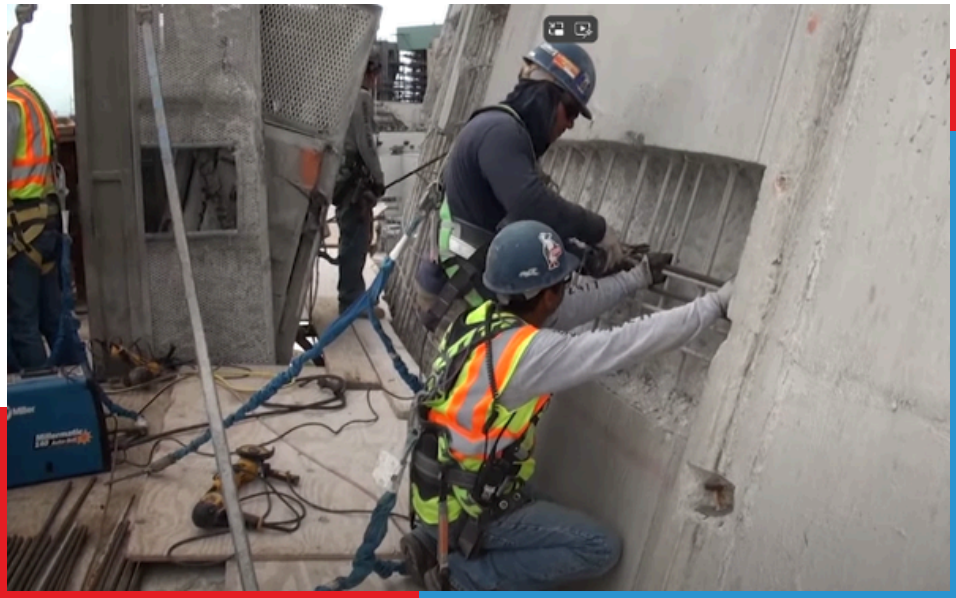
Internal Walkway:

General Condition: Check the walkway surface for slip resistance, and potential trip hazards like uneven sections or protruding fasteners. Inspect the supports and attachments that hold the walkway in place. Look for loose bolts, damaged brackets, or bent supports. Check handrails for stability, integrity, and height compliance. Ensure they are securely attached and free from damage.

CONCRETE ROUND MECHANICAL DRAFT COOLING TOWERS, LIKE ANY REINFORCED CONCRETE STRUCTURE, REQUIRE REGULAR INSPECTIONS TO MAINTAIN OPERATIONAL SERVICEABILITY AND DURABILITY.

COMMON ISSUES INCLUDE:

- **Development of meridional and circumferential cracks.** Regular monitoring is essential for the detection and assessment of these cracks that develop along the meridional (vertical) and circumferential (horizontal) lines of the structure.
- **Spalling.** This defect involves the breaking, chipping, or flaking off of concrete fragments, often due to reinforcement corrosion or freeze-thaw cycles. It requires prompt attention to prevent further deterioration.
- **Honeycombed concrete.** This refers to the presence of voids and gaps in the concrete that occurs when the mortar fails to fill the spaces around the aggregate particles completely, often leading to weakened structural integrity that needs thorough evaluation and repair.
- **Moisture penetration through the shell.** This issue involves water infiltrating the concrete structure, which can lead to corrosion of the reinforcement and degradation of the concrete itself. It is crucial to identify and rectify the causes of moisture penetration to maintain the structural health of the tower.



HANDS-ON INSPECTIONS

are crucial for assessing the extent and severity of these defects. Since such issues can develop and worsen over time, it is vital to conduct these inspections at regular intervals to monitor and address changes in the tower's condition. Access to the structure's full height is typically required, using specialized access methods.

1. The inspection of the tower should be conducted by a competent contractor who is experienced with this type of structure.
2. Any observations made during the inspection should be interpreted by qualified engineers familiar with such structures.
3. The tower owner must provide detailed construction drawings of the tower shell, packs, and basin. Additionally, if available, the owner should also provide developed elevation drawings of the tower, which the inspection company can use to mark all physical defects found during the inspection.
4. It is crucial during the inspection that all defects are measured and documented with specific height and radial coordinates. All cracks should be measured using a crack gauge at consistent intervals along the fracture to facilitate future monitoring of crack growth.
5. When cracks are identified, plastic survey targets should be affixed at each end for future monitoring from the ground using triangulation theodolites.
6. For areas with spalled or delaminated concrete, it is essential to record the depth of delamination, the concrete cover, the size, and the volumetric loss of exposed reinforcement.
7. If spalling penetrates the full depth of the shell, the overall wall thickness should be measured, recorded, and compared to the design thickness.
8. All defects observed during the inspection must be measured, documented, and plotted on a developed elevation drawing. The dimensional properties of each defect should be cataloged in a defect schedule, with each defect assigned a unique identification number.

REPAIRING CONCRETE IN MECHANICAL DRAFT COOLING TOWERS INVOLVE SEVERAL STRATEGIES AND TECHNIQUES, DESIGNED TO RESTORE STRUCTURAL INTEGRITY, ENHANCE DURABILITY, AND EXTEND THE LIFE OF THE TOWER.

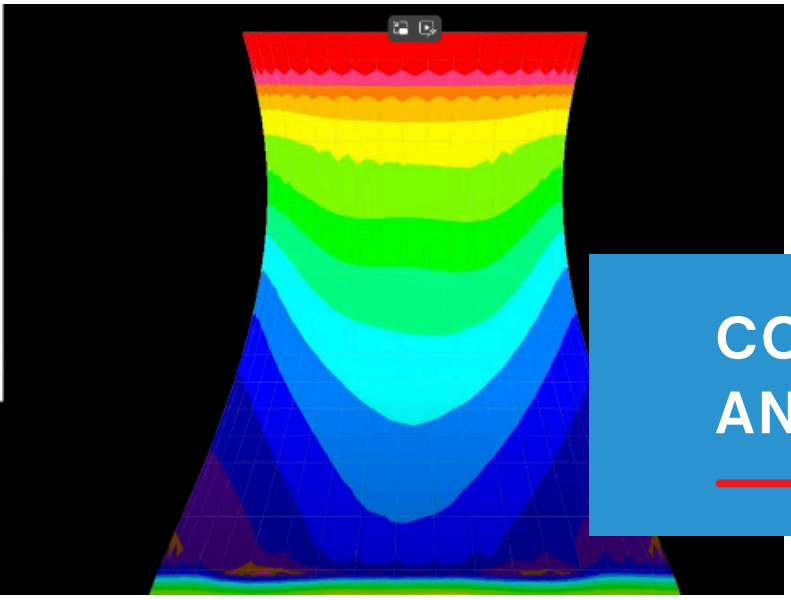
HERE ARE SOME COMMON METHODS USED FOR CONCRETE REPAIRS IN SUCH STRUCTURES:

- **Crack Injection:**
  - Epoxy Injection: Used for repairing structural cracks. Epoxy resins are injected under pressure into cracks to restore the original strength and loading capacity.
  - Polyurethane Injection: Applied in cases where water leakage is a problem, as polyurethane expands upon contact with water, effectively sealing the crack against moisture.
- **Concrete Patching:**
  - Surface Patching: For shallow repairs to address spalling or surface degradation. The damaged concrete is removed, and the area is cleaned before applying a new concrete mix or mortar.
  - Full-Depth Patching: Necessary when the damage extends through the thickness of the concrete element. This involves removing the damaged concrete to the reinforcement level, treating the rebar if needed, and filling it with new concrete.
- **Cathodic Protection:**
  - To prevent further corrosion of reinforcement in concrete, cathodic protection can be applied, especially in aggressive environments. This involves using sacrificial anodes that corrode in place of the reinforcing steel.
- **Application of Protective Coatings:**
  - Coatings such as elastomeric polymers can be applied to the exterior surfaces of the cooling tower to protect against environmental elements and reduce permeability, which mitigates moisture ingress and subsequent damage.
- **Reinforcement Replacement or Addition:**
  - In cases where the existing reinforcement has deteriorated significantly, it may be necessary to expose the reinforcement, remove the corroded sections, and replace them or add new reinforcement to ensure structural stability.
- **Structural Strengthening:**
  - Techniques such as fiber-reinforced polymer (FRP) wrapping can be used to enhance the load-bearing capacity of the concrete sections. This method involves wrapping carbon or glass fiber fabrics around concrete elements, effectively increasing their tensile strength.
- **Moisture Control and Waterproofing:**
  - Implementing waterproofing measures such as membranes or sealants on the interior and exterior surfaces can prevent moisture from penetrating the concrete and reaching the reinforcement. Each repair scenario requires a thorough assessment by structural engineers and specialists to determine the most appropriate methods based on the extent of damage, the specific environmental conditions, and the operational demands of the cooling tower. Regular maintenance and timely repairs are crucial to avoid more significant issues and ensure the long-term functionality of natural draft cooling towers.

FOR CONCRETE INSPECTIONS AND REPAIRS ON ROUND MECHANICAL DRAFT COOLING TOWERS, IT IS ADVISABLE TO ENGAGE A SPECIALIZED STRUCTURAL CONCRETE CONTRACTOR. THESE CONTRACTORS BRING THE NECESSARY EXPERTISE, ADVANCED TECHNOLOGIES, AND EXPERIENCE TO HANDLE THE UNIQUE CHALLENGES ASSOCIATED WITH INSPECTING AND REPAIRING THESE LARGE AND COMPLEX STRATEGIES.

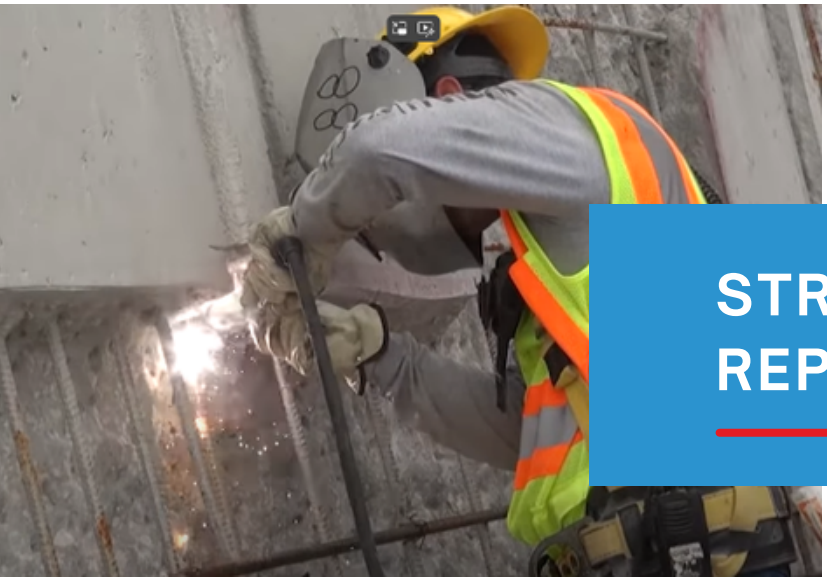
HERE'S WHY OPTING FOR SPECIALIZED CONTRACTORS IS BENEFICIAL:

- **Expertise in Specific Repair Techniques:** Specialized contractors are well-versed in the specific techniques required for repairing reinforced concrete cooling towers, such as epoxy and polyurethane injections for cracks, cathodic protection for reinforcement, and the application of protective coatings.
- **Access to Advanced Technologies:** They have access to the latest technologies and materials in the field of structural repair, which can ensure more durable and effective solutions.
- **Experience with Similar Structures:** These contractors typically have experience working on similar large-scale structures, which means they can anticipate potential issues and often provide more reliable and efficient service.
- **Safety Compliance:** Working on natural draft cooling towers involves significant safety risks due to their height and scale. Specialized contractors are equipped to comply with all relevant safety regulations and standards, reducing the risk of accidents.
- **Quality Assurance:** Specialized contractors are more likely to guarantee the quality of their work, providing peace of mind that the repairs will last and perform as required.
- **Cost-Effectiveness:** While possibly more expensive initially, hiring experts can be more cost-effective in the long run due to the high quality of work and the prevention of future issues.
- **Customized Solutions:** They can offer customized solutions tailored to the specific conditions and needs of your cooling tower, considering environmental factors, specific damage patterns, and the operational requirements of the tower. Engaging a specialized structural technology contractor ensures that the repairs are carried out with the highest standards of quality and safety, extending the life of the cooling tower.



COMPUTER LOAD ANALYSIS

CONCRETE TESTING



STRUCTURAL STEEL REPLACEMENT

STAR
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DESIGN, CONSTRUCTION, REPAIR, & UPGRADES SINCE 1951

The Integrity of Service and Technology

Outstanding Customer Service
The Star Performance Plus program is designed to offer you complete support for the proper maintenance, operation, and optimization of your new cooling tower.
The result is consistent thermal performance, reduced unplanned maintenance, and emergency downtime, and overall maintenance cost reduction.

- Cooling tower start-up & training services
- Performance testing
- Annual inspection services
- Maintenance planning & budgeting
- Scheduled maintenance services
- Emergency response plans & implementation

OEM Replacement Parts
Our large selection of quality OEM (Original Equipment Manufacturer) replacement parts are compatible with most models and manufacturers of cooling towers, and they offer a high-quality, reliable, low-cost alternative to expensive original equipment parts.

Call us today for more details on how we can be your best value cooling tower supplier.

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