

Title: **Pin Piles for SCR Foundations**

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Introduction

Nicholson Construction (Nicholson) has established itself as the U.S. authority for the design and construction of Pin Piles (micropiles) which are high capacity drilled and grouted steel pipe piles. Nicholson is the leading installer of Pin Piles in the U.S., having completed over \$130 million worth of Pin Pile foundations on over 130 projects across the country.

Nicholson has installed Pin Piles for multiple Selective Catalytic Reduction (SCR) upgrade projects for coal-fired power plants. We have gained much insight into the challenges associated with SCR retrofitting through our experience and interaction with consulting engineers, general contractors, specialty structural erectors, and power plant personnel. Pin Piles are the foundation system of choice for many SCR upgrades because of the following characteristics: 1)Vibration and impact to adjacent structures are minimal; 2)Pin Piles can be installed in limited-access areas such as building interiors, and below overhead structures; 3)Pin Piles can be installed adjacent to or through existing foundations to accommodate retrofitting and use/upgrading of existing foundations; and 4)Installation costs are relatively low.

Headquartered in Pittsburgh, PA, Nicholson is a leading specialty geotechnical contractor that has been providing innovative and cost-effective services in ground treatment, ground improvement and structural support for over 45 years. Our design and construction teams are among the most knowledgeable and experienced in the world. We are also proud to be the North American affiliate of the world's oldest specialty geotechnical contractor, Rodio Group based in Milan, Italy. For over 10 years Nicholson and Rodio have been working together, sharing technology, ideas, and resources for grouting and geotechnical projects worldwide.

SCR Upgrades

Due to recent United States Environmental Protection Agency (USEPA) mandates, many existing coal-fired power plants must reduce nitrous oxide (NO_x) emissions at their facilities by the year 2003. SCR technology is one option to effectively reduce these emissions.

The SCR units are commonly erected adjacent to or above existing structures and often require deep foundations to resist the large compression, uplift and lateral loads that are induced at the base of the structure. Many cases exist where it is not practical, possible, or economical to install more traditional deep foundation elements and the use of Pin Piles is most appropriate.

Pin Piles

Pin Piles are drilled-in elements typically ranging from 5 to 12 inches in diameter, which usually consist of steel pipe (casing), steel reinforcement, and cement grout. They derive capacity in the ground from side friction and perform very well in both compression and tension. Working load capacities typically range from 50 to 200 tons. Pin Piles are installed using rotary drilling techniques similar to those used in the oil and gas industry. Nicholson utilizes three drilling techniques: 1) Positive circulation or external flush drilling; 2) Duplex drilling; and 3) Rotary eccentric percussive Duplex drilling. The appropriate drilling method is selected based on the subsurface conditions and site accessibility. The piles derive their geotechnical capacity through grout to ground adhesion in the bond zone. In soils this bond is typically developed using pressure grouting and in rock, tremie grouting. The pile's structural capacity is provided by grout (typically 4 ksi), steel casing (typically 80 ksi), and reinforcing bar (typically 75 ksi).

Pin Piles are installed in a wide range of access and ground conditions which makes them ideally suited to working in and around existing power generation plant structures. The three following case histories demonstrate typical Pin Pile applications for SCR upgrades.

Confidential Coal-Fired Power Plant in West Virginia

A total of 393 Pin Piles were installed (designed and tested capacities of 300 kips in compression and 45 kips in tension). These piles, which consisted of 9-5/8 inch diameter outer casing and a No. 18 reinforcing bar, ranged in depth from 30 to 80 feet, and were installed through clay, sand, shale, and limestone. Many of the piles were installed within fan rooms or adjacent to existing structures, precluding the use of large pile driving or shaft drilling equipment. The Tubex method of drilling was utilized to advance the piles through the very difficult strata consisting of broken rock and fill.

Confidential Coal-Fired Power Plant in Kentucky

At this facility, a total of 119 Pin Piles were installed within 12 pile caps through strata consisting of dense silty sand, and sandy silt with clay. The Pin Piles consisted of a 95 foot long all-thread reinforcing bar centered within a 9-5/8 inch diameter outer casing. The casings were advanced using rotary external flush methods. A special polymer drilling fluid was used to maintain open boreholes. The pile caps keyed in to existing precipitator foundations. Many of the piles were located in areas of low headroom (approximately 12 feet) below precipitator ductwork and pipe racks. Load tests were performed to 400 kips tension and 800 kips compression (twice the design loads). The limited headroom precluded the use of larger equipment that is typically required for traditional deep foundation systems. Vibration caused by driven piles may have been damaging to the existing precipitator foundations.

Confidential Coal-Fired Power Plant in West Virginia

A majority of the 80 Pin Piles installed for this project were located within fan rooms in areas of very limited access. These piles were designed and tested to 300 kips in compression and 45 kips in tension. The piles, designed to support the new SCR platform, were installed through, and keyed in to the foundations for the fan room structures. These piles were installed using the Duplex method to overcome the very shallow groundwater levels and penetrate fill materials that contained obstructions. The tight access requirements of the project along with the difficult subsurface conditions made Pin Piles the foundation of choice for the design engineer of record. The Pin Piles were installed to an average depth of approximately 90 feet.