



Technology Overview



Novel tools to improve the interface behavior of adhesive anchors in concrete/rock

OTT ID #1553

TECHNOLOGY

The UWM Research Foundation presents a concrete tapping bit that creates regularly-shaped textures or grooves along the lateral surface of drilled holes to secure adhesive anchors or reinforcement bars in concrete/rock. Dr. Jian Zhao, Associate Professor of Civil and Environmental Engineering at the University of Wisconsin-Milwaukee, is spearheading the development of this new tool to improve the capacity and safety of adhesive anchoring systems, including epoxy anchors and reinforcing bars.

Premature and unintended adhesion failures have resulted from undesired cooperation of the adhesive with the lateral surface of the bore and/or the surface of the anchor. For example, on July 10, 2006, the adhesive anchors failures resulted in the unexpected multiple tunnel ceiling panels and associated debris inside the Fort Point Channel Tunnel in Boston Massachusetts. On December 2, 2012, a similar collapse of ceiling occurred in the Sasago Tunnel in Japan. Subsequent investigation showed that the failure began with the simultaneous creep failure of several anchors which precipitated the gradual creep failure of adjacent adhesive fasteners.



The adhesive-concrete bonding can be detrimentally affected by various conditions including dust or debris left in the drilled hole, temperature and humidity conditions associated with the underlying concrete as well as placement, operation, and curing of the adhesives, freeze/thaw cycles, etc. A field study conducted in 2011 of anchor installation at construction sites in California, Florida, Illinois, New York, and Pennsylvania indicated that nearly none of the drilled holes were properly cleaned prior to introduction of the adhesive and/or anchor or fastener. Although substantial improvements in the safety of adhesive anchors resulted from the implementation of American Concrete Institute (ACI) Code 5 and a new ACI 355.4-11 standards and the fast-tracking of adhesives anchor certification programs by ACI Committee 318, Structural Concrete Building Code.

Despite these initiatives, shortcomings remain prevalent in achieving the desired interaction between the anchor or fastener, the adhesive, and the bore's lateral surface. This concrete tapping tool provides a method of securing adhesive anchors and reinforcement bars that repeatable, robust connection methodology that works around this adhesion problem.

FEATURES/BENEFITS

Improves Reliability of Adhesive Anchors



Simplifies Anchor Installation Protocol by minimizing cement bore cleaning step



Enhances Adhesive Anchor Tensile Capacity by minimizing adhesive creep

Versatile Conventional adhesives, anchors and reinforcing bars can be used



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INTELLECTUAL PROPERTY

A US provisional patent has been filed.

This technology is part of an active and ongoing research program and is seeking partners for development of the final product. It is available for developmental research support/licensing under either exclusive or non-exclusive terms.

MARKETS

The masonry market in the United States has grown by 4.7% to reach a total revenue of \$27 billion in 2018, with the number of businesses increasing by 1.1% and the number of employees growing by 2.6%. Residential construction, including new construction, alterations and repair work contributes significantly to the market.¹

The US road and highway construction market has grown by a modest 3.6 % to reach a total revenue of \$128 billion in 2018² with California, Florida, Hawaii, New York, Virginia and Washington states having the highest projected growth.³ Globally, the road, highway and bridge market are expected to reach \$2.2 trillion at a CAGR of 8.4% for a period beginning in 2017. Much of this growth is projected to occur in Asia.

INVENTOR

Jian Zhao, Ph.D.

Dr. Jian Zhao is an Associate Professor of Civil and Environmental Engineering at the University of Wisconsin-Milwaukee with research interests and expertise in Earthquake engineering, Behavior and seismic design of concrete structures, Structural modeling, Real-time dynamic testing and Advanced energy-dissipation materials and applications. He is a member of the Earthquake Engineering Research Institute (EERI), the Network for Earthquake Engineering Simulation (NEES), the American Society of Civil Engineers (ASCE), and the Precast/Prestressed Concrete Institute (PCI). Dr. Zhao is the secretary of Joint ACI-ASCE 447 Committee, Finite Element Analysis, and a voting member of ACI Committee 355, Anchorage to Concrete. Dr. Zhao is also a member of SAG 4, Anchorage in Concrete and Masonry, which is a part of the International Federation for Structural Concrete.

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- 1) <https://www.ibisworld.com/industry-trends/market-research-reports/construction/special-trade-contractors/masonry.html>
- 2) <https://www.ibisworld.com/industry-trends/market-research-reports/construction/heavy/road-highway-construction.html>
- 3) <https://www.artba.org/2017/11/30/modest-growth-2018-transportation-construction-market-artba-forecast-finds/>
- 4) <https://www.marketwatch.com/press-release/the-global-highway-street-and-bridge-construction-market-will-grow-from-15-trillion-in-2017-to-22-trillion-by-2022-with-a-compound-annual-growth-rate-cagr-of-84-for-the-period-of-2017-2022-2018-02-26>