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civil + structural ENGINEER

CELEBRATING THE **TOP 100** OF THE WORLD AROUND US

VERTICAL CONSTRUCTION IN THE MIDDLE EAST

DESIGNING RESIDENTIAL BUILDINGS ABOVE SUBWAY TUNNELS
BUILDING WITH MASS TIMBER
ADAPTIVE REUSE IN HOUSTON





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BAUGRID® REINFORCEMENT ENABLES THE WORLD'S SECOND TALLEST BUILDING TO SOAR INTO THE SKIES OF KUALA LUMPUR

By Al Anvari, P.E.

IN 2015, when the project team was confronted with the complex constructability challenges and confinement reinforcement design issues for the construction of the world's 2nd tallest building, they turned to BauGrid Reinforcement for solution.

This extraordinary project, Merdeka PNB-118 (aka PNB-118), is a 118-story, 644 m (2,113 ft) tall Skyscraper that is nearing completion in Kuala Lumpur, Malaysia. It is currently the tallest building under construction in the world. The structure with its exclusive spire was inspired by and resembles a unique silhouette of Malaysia's then Prime Minister, raising his hand during the 1957 assembly at this site, while chanting "Merdeka" (which means "Independence"), marking their independence from Great Britain.

The designers of super tall concrete structures who need to provide for resistance to high axial compressive forces, strong cyclone or typhoon winds, and blast forces, must consider the balance of strength and ductility in their design approach. Increasingly, engineers are specifying higher strength concrete while the ductility is maintained through careful detailing of the reinforcing. When properly designed and detailed, it is the transverse reinforcement that provides the concrete with ductility through enhanced confinement of the longitudinal reinforcing steel. Since early last century, this has been achieved by using closely spaced hoops, stirrups, and crossties. However, today's mega tall structures, designed in accordance with the more stringent code requirements for this century, require rebar bends, hooks, and hook extensions in their transverse assemblies that, quite often, result in labor-intensive construction, reinforcement congestion, and concrete placement challenges.



Photo 2



Photo 1

One-piece BauGrid reinforcement can replace the many pieces of conventional transverse reinforcement. The resistance-welded intersections replace cumbersome end hooks and provide a more exact and efficient system for placement of longitudinal and confinement reinforcement. The system significantly improves forming and concrete placement, enhancing concrete consolidation and increasing construction speed.

The Design Engineers and Construction Team for PNB-118 Tower selected BauGrid Reinforcement in the most congested column sections of the core wall, at the lower levels of the structure. Many large U.S. and international engineering and construction companies had already discovered the benefits of this transverse reinforcement system by completing many important projects, such as the 60-story residential tower in San Francisco to mark the tallest reinforced concrete structure in California, USA; the world's tallest precast concrete structure in the region of highest seismicity in San Francisco, USA; and the world's tallest tunnel form structure, built in the most severe earthquake zone,

PROJECT CREDITS:

Location: Kuala Lumpur, Malaysia

Owner: PNB Merdeka Ventures Sdn Bhd

Architect of Record: RSP Architects SDN BHD, Malaysia

Concept and Design Architect: Fender / Katsalidis Architects, Australia

Engineer of Record: ARUP Jururunding, SDN BHD, Malaysia

Structural Design Engineers: LERA Leslie E. Robertson Associates, New York

General Contractor: Samsung C&T Construction & Engineering, Seoul, Korea

Project Manager: Turner International

time for the reinforcing cages. BauGrid reinforcement grids, manufactured from engineer-approved shop drawings, remove the need for fabrication and site supervision of the tie assembly by arriving on site or in the yard as a custom-fabricated, dimensionally accurate, single-piece grid. By eliminating the lengthy end hooks, these grids weigh less than their conventional tie assembly counterparts and provide a uniform product that can be quickly assembled with the longitudinal steel to form rigid and stable cages. The improved rigidity and reduced weight of the grids allow for easier handling, thereby reducing crane and labor time for installation, further reducing costs by speeding up the construction. The consistency and accuracy of the rigid cages provide a perfect facade for rapid formwork installation. The reduced cage congestion increases the speed of concrete placement, facilitates the vibration process, and improves concrete consolidation.

"There is no better way to build reinforced rebar cages for high rise structures than with BauGrid Reinforcement. The system helped us reduce rebar congestion significantly and made the construction of our largest columns possible. The system facilitated accurate and efficient application of self-climbing forms for the most congested area at the bottom 6 floors. The consistency and precision of longitudinal rebar placement using BauGrid significantly improved form climbing and concrete placement." -Mr. Kamal Kang, Senior Construction Manager, Samsung C & T Construction, South Korea.



Industry innovations such as welded reinforcement grids, combined with performance-based design approaches, continue to make concrete the material of choice for owners and help design and construction engineers to find new ways, means, and materials to meet the demands of this new millennium.



AL ANVARI, P.E. has been a registered professional engineer in the State of California, USA since 1983 and has over 35 years of experience in building design, construction system development and marketing. He founded BauGrid USA, LLC to design, manufacture, and distribute the advanced concrete reinforcement systems in the Asian and North American markets. He can be reached at al@baugridusa.com.