How ACI Shaped Concrete Codes and Practice in Indonesia, Part 1

From inspiration to integration

by Nuraziz Handika, Prasanti Widyasih Sarli, Josia Irwan Rastandi, Mulia Orientilize, and Jessica Sjah

In the decades that followed Indonesia's independence in 1945, the country began building its infrastructure and the technical foundations that would support it. Engineering standards became essential to this nation-building effort; inherited colonial codes evolved toward systems shaped by the people's own needs and realities.

Indonesia's first concrete design code, PBI 1955 (Peraturan Beton Indonesia [Indonesian Concrete Code]), was a direct translation of the Dutch GBVI (Gewapend Beton Voorschriften in Indonesië [Reinforced Concrete Code in Indonesia]).[1] While it provided a starting point for material quality and gravity load design, it offered little guidance for the realities of building in one of the world's most seismically active regions.

Since the 1960s, Indonesian engineers have recognized this gap and began looking beyond Europe for solutions, especially when dealing with complicated or monumental structures. They incorporated provisions from ACI, particularly for seismic detailing, alongside influences from other earthquake-prone countries, such as New Zealand. This marked the beginning of ACI provisions being adopted into the Indonesian Building Code. Many involved in drafting the 1971 PBI Code[2] went on to form Himpunan Ahli Konstruksi Indonesia (HAKI [Indonesian Society of Civil and Structural Engineers]), establishing the association as a national platform for advancing construction knowledge and practice.

This relationship deepened over the following decades, from partial adoption of ACI provisions in the 1970s and 1980s to full alignment with ACI's design philosophy by the early 2000s. Today, it extends beyond codes into joint efforts in certification, professional training, and knowledge exchange.

Through ACI and HAKI's shared commitment to excellence, a code born from Dutch origins evolved into a modern standard tailored to Indonesia's seismic realities.

1955: Dutch Legacy—Indonesia's First Concrete Code

Indonesia's first concrete design code, PBI 1955, was born directly from its colonial heritage.[1] Issued a decade after independence, it fully adopted the Dutch GBVI 1935, itself an evolution of earlier Dutch codes dating back to GBV 1912.[1] Chaired by R. Soemono, the drafting team retained the elastic design theory of its European predecessor, complete with the *n*-coefficient for the modulus ratio of steel to concrete, and focused on minimum material strengths and simple gravity load calculations.

Unfortunately, PBI 1955 lacked requirements for earthquake detailing or capacity design concepts, leaving structures vulnerable in Indonesia's high-seismic environment. The 1963 and 1965 revisions did little to address this gap; provisions for stirrup spacing, hook detailing, and ductility would only emerge decades later.

PBI 1955 marked a milestone as the nation's first formal concrete standard. Issued under the Dewan Normalisasi Indonesia (Indonesian Standardization Council), it is the forerunner of today's Badan Standardisasi Nasional (BSN [National Standardization Agency]) and the starting point for Indonesia's journey toward modern, performance-based codes. However, for complex or monumental projects, engineers often relied on alternative standards. The design of the National Monument (Monas, Monumen Nasional, Fig. 1), initiated in 1959 and inaugurated by Indonesia's first President Sukarno, on August 17, 1961, used "Tentative Recommendations for Prestressed Concrete"[3] (by Joint ACI-ASCE Committee 323). Led by Architects Soedarsono

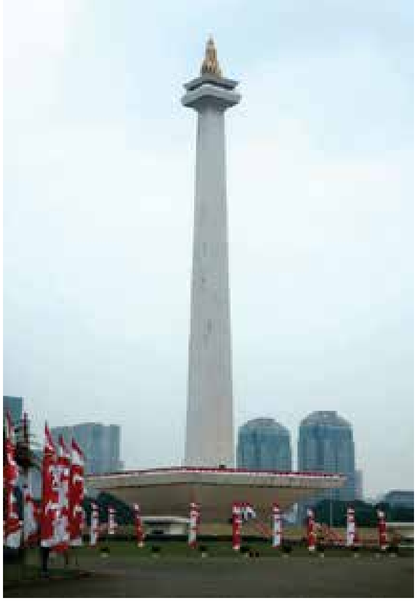

Fig. 1: The National Monument (Monas, Monumen Nasional), Jakarta's 132 m (433 ft) national monument, symbolizes Indonesia's independence *(photo courtesy of Josia Irwan Rastandi)*

Fig. 2: Wiratman Wangsadinata (born 1935), a pioneering figure in Indonesian civil engineering and Chair of the PBI 1971 drafting team. In 1991, he led a team integrating ACI and NZS provisions into national concrete standards, laying the foundation for modern seismic detailing in Indonesia. Founder of PT Wiratman & Associates, he designed Indonesia's landmark projects, shaping the nation's infrastructure and engineering practice *(photo courtesy of Wangsadinata's family)*

and Frederich Silaban, with Structural Engineer Rooseno, the project became one of Indonesia's earliest applications of prestressed concrete. Hamid Shahab, one of Rooseno's engineering team, stated in his book[4] that quality control, mixing, and placing of concrete referred to the ACI Code. The use of an ACI standard for a symbolic and technically demanding structure emphasized the practicality and relevance of U.S. codes in Indonesia, foreshadowing their formal incorporation into the 1971 PBI Code[2] a decade later.

1971: Combining Global Knowledge—PBI's First Step Toward ACI

By the early 1970s, Indonesia's engineering community was part of a global effort to harmonize reinforced-concrete practice coordinated through Conseil International du Bâtiment (CIB), Comité Européen du Béton (CEB), Fédération Internationale de la Précontrainte (FIP), International Organization for Standardization (ISO), and ACI. Within this context, PBI 1971[2]—led by Wiratman Wangsadinata (Fig. 2)—drew on the international recommendations and on major national codes, including ACI CODE-318-71: Building Code Requirements for Reinforced Concrete[5] (United States), CP 110:1972[6] (United Kingdom), and Voorschriften Beton (VB) 1972 (the Netherlands)[7]; refer to Fig. 3. Rather than a simple merger of three codes, PBI 1971[2] positioned Indonesia inside the emerging consensus on notation, safety concepts, and design methodology. It adopted the elastic-ultimate approach—retaining elastic checks with usage/material/load factors from European practice and using ultimate-strength design with factored loads—and set a uniform load factor of 1.5 for dead and live loads.

Concrete quality was assessed using cube samples (K grade), with minimum $f_c' = 14.5$ MPa (K-175), equivalent to 2100 psi, and a maximum steel yield strength of 390 MPa

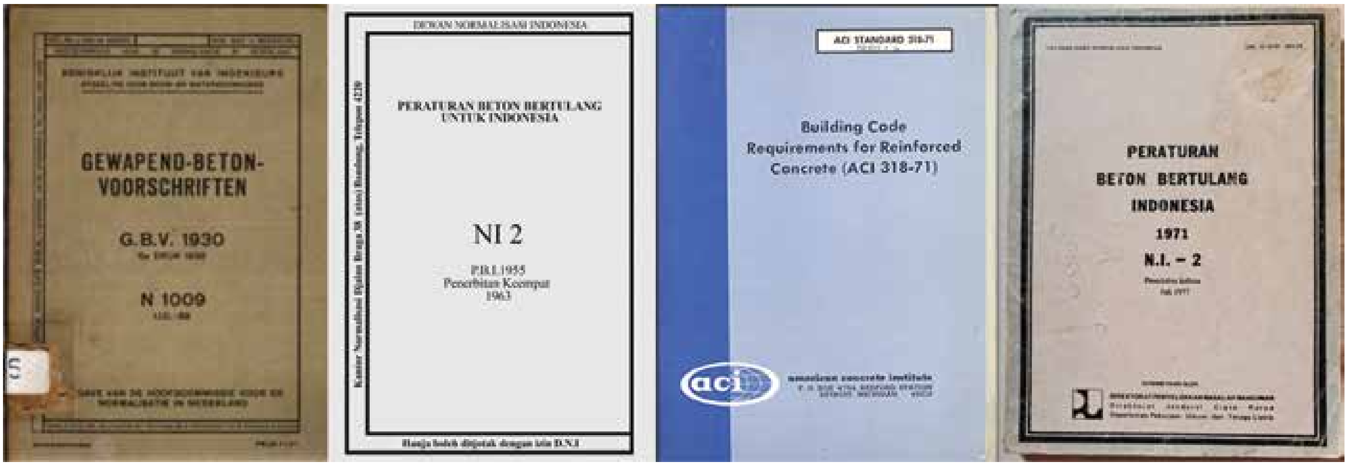

Fig. 3: Covers of key reinforced concrete codes that shaped Indonesia's concrete design standards. From left to right: Dutch GBV 1930 forming the basis of Indonesia's early codes; PBI 1955, the first Indonesian reinforced concrete code derived from Dutch regulations; ACI 318-71 Building Code,[5] later referenced in Indonesia; and PBI 1971,[2] the first Indonesian code to integrate ACI provisions with existing Dutch-based rules *(photo courtesy of Josia Irwan Rastandi and Prasanti Widyasih Sarli)*

(U-39), equivalent to 56,500 psi. For earthquake-resistant buildings, stirrup spacing rules appeared for the first time, though the strong column-weak beam principle was not yet adopted.

While not a seismic code, PBI 1971[2] marked a shift toward American seismic detailing in a high-risk context, becoming the structural backbone for many of Jakarta's buildings in the late 1970s and 1980s.

1980s–1991: Seismic Wake-Up Call and the Road to SK SNI

Although PBI 1971[2] integrated some ACI concepts, it lacked key seismic detailing: strong column-weak beam philosophy, special confinement, and explicit capacity design rules. The urgency of these omissions became clear in 1976, when a magnitude 6.5 earthquake in Seririt, Bali, destroyed schools and other structures, killing dozens of students.[8-10]

This tragedy prompted Indonesia's first dedicated earthquake guidelines: *Pedoman Perencanaan Tahan Gempa* (PPTG [Earthquake-Resistant Design Guidelines]), 1981, developed with New Zealand's Beca Carter Hollings & Ferner (BCHF).[1] It introduced ductility (*K*) factors and capacity design concepts, reducing design forces based on a structure's deformation capacity. However, detailing remained basic. For example, hooks were still 90 degrees and stirrup spacing was relatively wide.

By the late 1980s, more Indonesian engineers had trained in the United States and New Zealand and sought to modernize the code with lessons from ACI CODE-318 and New Zealand Standards (NZS). This momentum culminated in a unified, performance-oriented code, SK SNI T-15-1991-03.[11]

1991: U.S. and New Zealand Synergy—SK SNI T-15-1991-03

SK SNI T-15-1991-03[11] marked Indonesia's first true integration of international best practices into a national code. Led by the late Wiratman Wangsadinata, with key contributions from Dradjat Hoedajanto and Indra Djati Sidi, the standard blended ACI CODE-318-83[12] structural design rules with New Zealand's capacity design philosophy for seismic detailing. It introduced modern load factors of 1.2 (dead) and 1.6 (live), adopted a conservative shear reduction factor ($\phi_v = 0.6$), and emphasized strong column-weak beam behavior, ending decades of mixed practice where structural and seismic design were treated separately.

Code Alignment Deepens: From SK SNI 1991 to Full ACI Adoption

Building on this milestone, Indonesia moved toward closer alignment with ACI. SNI 03-2847-1992[13] embedded ACI's non-seismic provisions into the national standard, while SNI 03-2847-2002[14] became the first to adopt ACI 318M-99[15] comprehensively, with only minor local adaptations such as cube strength testing (K grade) and adjustments for local materials. For seismic zones, the strong column-weak beam principle became mandatory.

Since then, updates have kept Indonesia's code closely aligned with ACI:

- SNI 03-2847-2013[16] adopted ACI 318M-11,[17] reorganizing code structure and clarifying seismic detailing requirements for beam-column joints, special walls, and diaphragms; and
- SNI 2847:2019[18] adopted ACI 318M-14[19] and selected provisions from ACI 318M-19,[20] aligning closely with SNI 1726:2019[21] (seismic loading standard) for seamless integration of structural design and seismic hazard mapping.

This progression represents more than technical updates. It marks a cultural shift from informal referencing of ACI provisions to systematic integration through a rigorous process of evaluation, adaptation, and harmonization. Expert teams from HAKI, BSN, and academic institutions now work continuously to ensure that each revision of SNI reflects the latest technical developments from ACI, improving safety and consistency and enabling Indonesian engineers to engage more actively in global engineering practice.

Figures 4 through 7 highlight several landmark buildings in Indonesia that were designed under the respective building codes of their time. All of them still stand strong today.

A Partnership Framework: ACI-HAKI International Agreement

As Indonesia's use of ACI-based standards matured, opportunities arose for more structured collaboration. This culminated in ACI and HAKI formalizing their relationship through an International Partner Agreement in 2017.

The signing marked a milestone for both organizations. Representing ACI was Ronald G. Burg, former Executive Vice President, and for HAKI, the late Dradjat Hoedajanto, then President of HAKI. The agreement recognized HAKI as ACI's formal International Partner, affirming its role as Indonesia's national society for civil and structural engineers.

The partnership created a framework for long-term cooperation in technical knowledge exchange, access to ACI resources and publications, support for education and certification, and participation in international forums and code development. More than a one-way transfer of knowledge, it emphasized mutual engagement and professional growth, reflecting a shared vision to raise the quality of concrete practice through collaboration and inclusion.

This framework has since strengthened ties between engineers, educators, and institutions in both countries, laying the groundwork for the eventual launch of the ACI Western Indonesia Chapter, discussed in Part 2 of this article series.

Building the Foundation

Indonesia's journey with ACI, from the adoption of seismic detailing in PBI 1971[2] to the full integration of ACI CODE-318 into national standards, represents more than technical progress. It reflects a long tradition of collaboration and shared commitment to safer, higher-quality concrete design.

This history was shaped not only by codes but also by individuals and institutions. Indonesian engineers trained in the United States played a pivotal role in transferring ACI knowledge back home by applying it in practice, teaching it in classrooms, and weaving it into local codes. Their efforts laid the foundation for a generation of engineers grounded in international best practices.

Support from ACI leadership has also been crucial. Special recognition goes to the late Dradjat Hoedajanto, whose leadership as HAKI President helped formalize the 2017 ACI–HAKI agreement. His vision continues to shape how Indonesian engineers engage with global standards. We also acknowledge the support initiated and fostered by Ronald G. Burg, continuing with Frederick H. Grubbe, current ACI Executive Vice President, and many at ACI who welcomed Indonesia into a wider community of practice.

Looking Ahead: From Code to Community

This article outlines how Indonesia built a foundation through decades of engagement with ACI standards. Part 2 will explore how that foundation evolved into an active professional community through the formation of the ACI Western Indonesia Chapter, with initiatives in education, certification, and outreach that connect Indonesia to the global concrete industry.

Fig. 4: Ratu Plaza, Jakarta—One of the earliest high-rise applications of PBI 1971,[2] designed by PT Wiratman & Associates. The project integrated ACI and VB standards and employed a tube-in-tube system (perimeter columns resisting lateral loads, a central core carrying vertical loads, and a prestressed flat slab linking them), enabling column-free interiors and improving earthquake vibration dissipation *(photo courtesy of Josia Irwan Rastandi)*

Fig. 5: Wisma Dharmala (Intiland Tower), Surabaya—Completed in 1997, this 12-story office tower by Benjamin Gideon & Associates, with architect Paul Rudolph, was designed under SK SNI T-15-1991-03[11] combining ACI concrete testing and New Zealand seismic detailing. Though it used 90-degree hooks and wider stirrup spacing, the structure followed capacity design principles within a reinforced concrete frame adapted to Surabaya's tropical climate, featuring natural ventilation and sun-shading. Paul Rudolph also designed Wisma Dharmala (Intiland Tower), Jakarta, in the mid-1980s with PT Wiratman & Associates, a tropical modernist landmark known for its stepped terraces, shaded atriums, and bold geometric form that redefined the high-rise design in the capital *(photo courtesy of Josia Irwan Rastandi)*

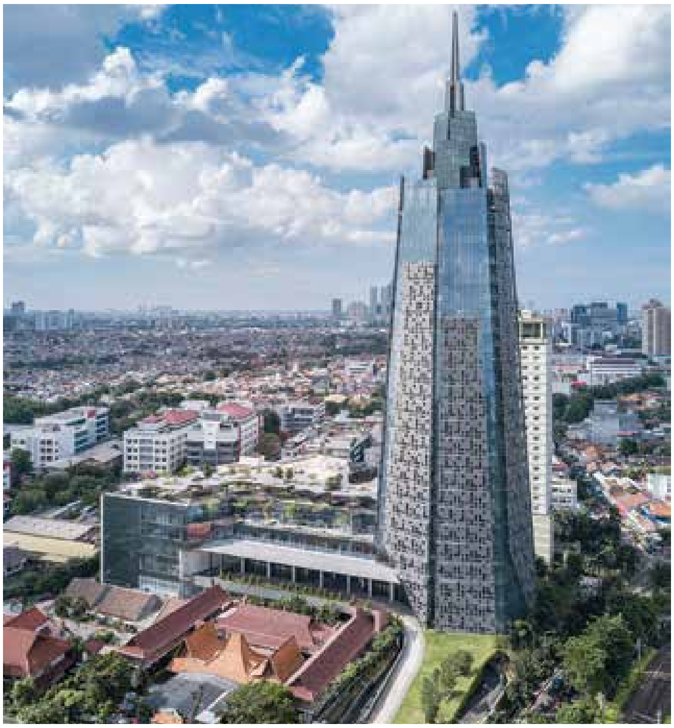

Fig. 6: Kompas Multimedia Towers, Jakarta—Structural design by PT Davy Sukamta & Partners under SNI 03-2847-2013[16] (ACI 318M-11[17]). This 25-story building with a three-level basement has a gross building area of approximately 57,000 m^2 (68,000 yd^2), completed in 2017. This modern development deploys a reinforced concrete core wall and open-frame structural system on bored pile foundations, optimizing resistance to both seismic and wind forces *(photo courtesy of PT Davy Sukamta & Partners)*

Fig. 7: Autograph Tower (Thamrin Nine), Jakarta—the tallest building in the Southern Hemisphere at 382.9 m (1256 ft)[22]— was completed in 2020 and designed per SNI 2847:2019[18] (ACI 318M-14[19]). Featuring performance-based seismic design with 135-degree hooks and tightly spaced crossties, it exemplifies modern earthquake safety and evolving national concrete standards. Structural engineering was provided by Wiratman & Associates *(photos courtesy of Indra Djati Sidi)*

The momentum continues and so does the invitation. We welcome colleagues, chapters, and institutions worldwide to collaborate in shaping the next era of innovation, quality, and safety in concrete construction.

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Selected for reader interest by the editors.

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