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Kuwait Chapter

Concrete News

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Volume 28 / January 2024

Cover : The Assima Mall, Kuwait City.

Kuwait Chapter

Local Connection with International Links

Concrete News

Concrete News is published by ACI-Kuwait Chapter for sharing information, promoting exchange of technical knowledge amongst its membership, and enhancing the Chapter's position within Kuwait's engineering fraternity.

Volume 28 / January 2024

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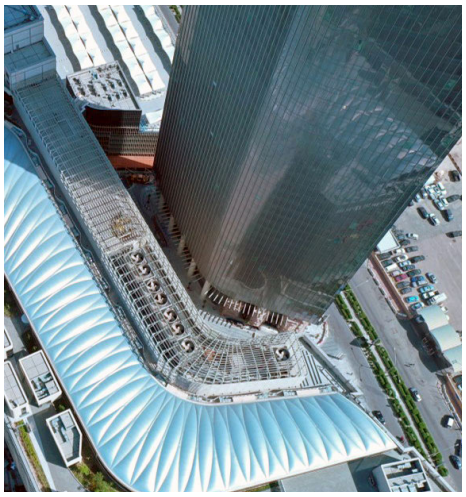


President's Message

ACI-KC President, Mr. Ghassan Al Ghawas

ACI-Kuwait Chapter published it's first Concrete News in 1998, and since then has proudly continued issuing the magazine with information relating to concrete science and industry, and the Chapter's mandate and activities, This issue #28 carries on the same spirit and enthusiasm in the hope that readers will find it as informative and exciting.

The Board of Directors held regular meetings for reviewing the Chapter's goals, inspirations, and challenges, with the intent to establish a stronger foundation with added benefits to regain interest of our members to actively participate in our activities and attract new members to join the Chapter.

The Committees' efforts as they endeavoured to accomplish their mandates have to be much appreciated. Our activities varied from normal Chapter membership and management affairs, to techincal seminars, social events, site visits and prestigious awards ceremonies.

This issue of Concrete News highlights the past year's activities, and includes more articles that we hope will meet your interest and expectations.

Annual Awards 2021-2022

Every year ACI Kuwait Chapter recognizes and presents two awards, one for an outstanding project and the other to a deserving individual. These Awards are presented during the Chapter's highly anticipated grand Awards Banquet. The Chapter has been presenting these awards since 2001.

This year's well attended awards ceremony was held at the Palms Hotel, under the patronage of Her Excellency, Ms. Amani Suleiman Bu Qamaz, Minister of Public Works and Minister of Electricity, Water and Renewable Energy.

ACI KC Annual Awards Function, May 2023

Eng. Eman Ahmad Al Omar, Asst. Undersecretary for Governmental Centre for Testing Quality Control and Research Sector who represented the Minister

Mr. Azizz Mamuuji, ACI-KC President 2022-2023, presenting the awards winners

Dr. Khaldoun Rahal, ACI-KC Director and Master of Ceremonies

Award of Excellence 2022

The Award of Excellence is bestowed on a local project of outstanding merit. The award, comprising a trophy, plaque and certificate, is given to the owners or developers of the project. Certificates of Excellence and plaques are also presented to the general or main contractor; the design and supervision consultants; and the main concrete supplier.

This year ACI-KC honoured Assima Development, located in the ehart of Kuwait City. The project was appreciated as “an innovatively and sustainably designed mixed-use urban centre landmark development that combines sophisticated structural

All awardees with Eng. Eman Ahmad Al Omar, Assistant Undersecretary for Governmental Centre for Testing Quality Control and Research Sector, who presented the awards On behalf of Her Excellency, the Minister of Public Works

and concrete engineering with aesthetic grace". The award was presented to Salhia Real Estate Company and it was received by the Chairman, Mr. Ghazi AlNafisi.

Award of Achievement

ACI Kuwait Chapter's Award of Achievement is presented to an individual to recognize his or her long-standing and commendable contribution to Kuwait's development. The award this year posthumously honoured Mr. Hamad Thunayan Alghanim for his "lifetime dedication and commitment to the engineering profession in Kuwait, to promoting ethical standards in professional practice and selfless service to humanity.

The ACI KC Award of Excellence Trophy being received by Mr. Ghazi Al Nafisi, Chairman of Salhia Real Estate Company

Mr. Tarek Shuaib receiving the Award of Excellence on behalf of PLP Architecture, England and PACE of Kuwait

Mr. Tarek Shuaib receiving the Award of Excellence of behalf of PLP Architecture, England and PACE of Kuwait

Mrs. Laila Alghanim receiving the Award of Achievement that was posthumously bestowed on Mr, Hamad, Thunayan Alghanim

Family of Mr, Hamad Alghanim at the Awards Ceremony

Award of Excellence 2022

ACI-Kuwait Chapter bestows the Award of Excellence on a project in recognition of its architectural and structural design attributes, outstanding use of concrete and quality of construction.

Criteria

The Chapter's highly respected Award of Excellence is given to a deserving project that has been completed in the preceding two years. This year's award covered the period 2021-2022. The Award recognizes various aspects of substantially completed projects;

- Outstanding work in concrete construction and practices.
- Innovative architectural and structural design.
- Interpretation of culture and traditions.
- Quality and standards of construction.
- Approach to sustainable design.
- Creative use of concrete
- Renewal and reservation works.
- Public appreciation of a project.

The Assima Mall

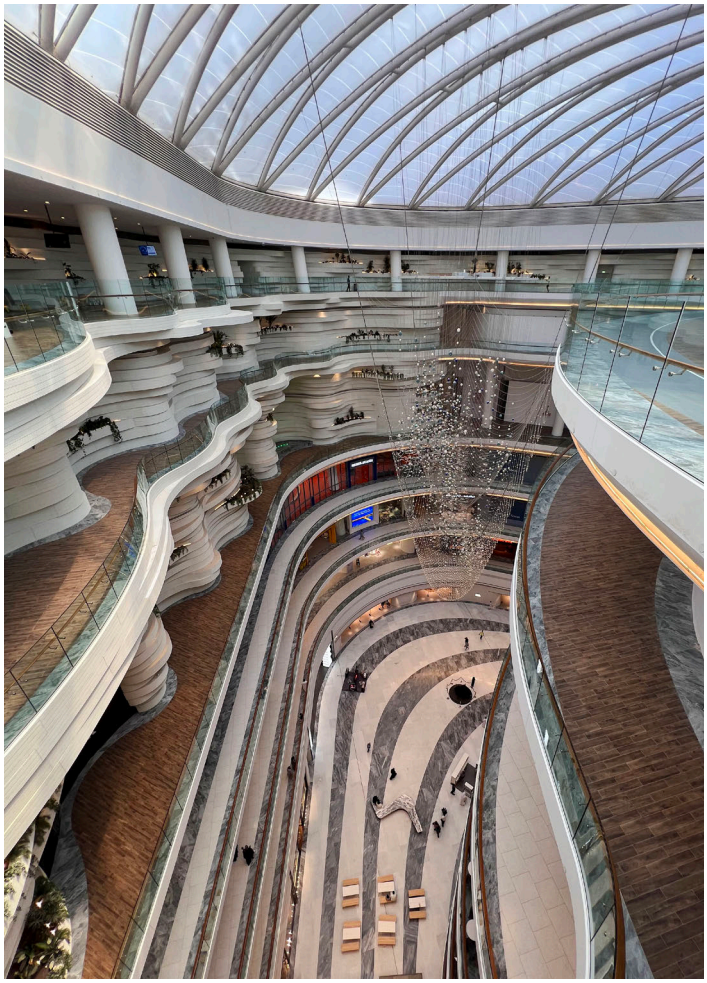
The award is presented to the developer of the project, but it also acknowledges the design and supervision consultants, general contractor and the main concrete supplier.

Awardee

The Award of Excellence for year 2022 was presented to Salhia Real Estate Company's multi-function commercial development, located in Kuwait city centere the Assima. The project was honoured as 'an innovatively and sustainability designed mixed-use urban centre landmark development that companies sophisticated structural and concrete engineering with aesthetic grace'. The grand award ceremony was conducted on at the Palms Hotel.

Vision and History

It was back in 1999 that Mr. Ghazi AlNafisi, Chairman of Salhia Real Estate Company, had the vision to develop a world class high-end retail, leisure, hospitality and office complex located right in the heart of Kuwait City. He wanted it to become a popular commercial, civic and cultural destination of choice. To manifest this vision, he invited three internationally known consultants to present conceptual ideas and although one design was selected, the project went into a hiatus due to land related issues. These were eventually resolved and the grand vision was revived in 2013.



Design Brief

The project's prominently located urban centre site measured 40,000 m^2 in area, and the development brief was clear and ambitious. The intent was to maximise utilisation of the premises, and create an iconic landmark which reflects Kuwait City's continuous growth.

The objective was to develop a vibrant, culturally appropriate and sustainably designed mixed-use urban centre landmark. It should be efficiently engineered and enhanced with spacious public areas, extensive landscaping and convenient connectivity between its components.

The result was Assima Development, an architectural icon that comprises a large podium with seven floors of retail space; serviced hotel apartments atop the podium; a 55 storey office tower; and structured parking for over 1700 cars.

As an integrated multi-function development, it certainly capitalises on its prominent location. Its grand scale, design and articulation of its components together create a visually exciting architectural complex that projects a strong presence in the heart of the City. The designers say that every component has been conceived to harmoniously contribute to the overall composition.

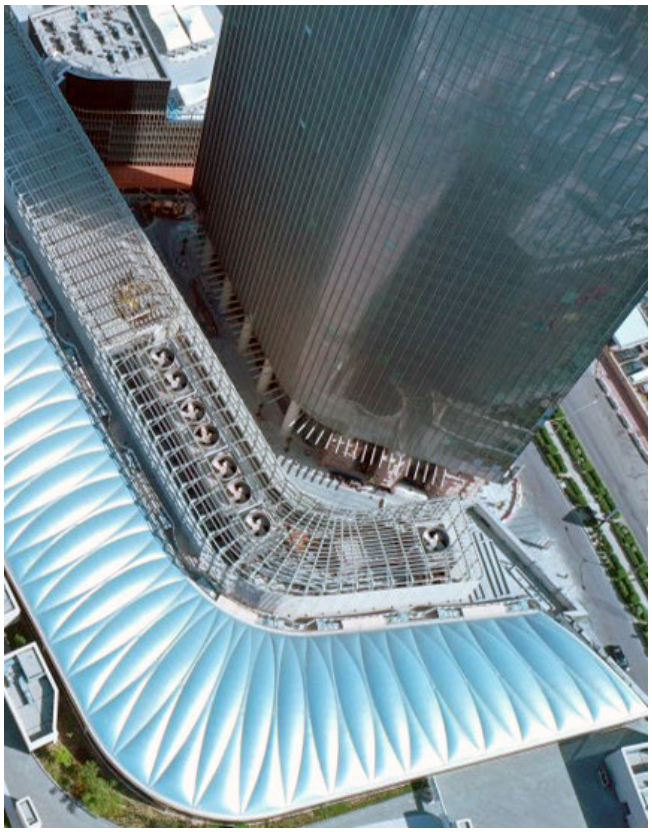
Site and Development Features

The context of the Project's 40,152 m^2 site in the middle of the City's business district is formed by a number of major recent buildings of contemporary design. Assima, however, has its own distinct identity in terms of scale and design features.

With a gross area of over 184,000 m^2, the retail and leisure mall is spread over the ground floor and six upper levels. The commercial component comprise retail and F&B outlets, major anchor stores, cinemas and family entertainment, a food court, and a weather tempered roof garden.

The 12 storey hotel sits atop the 7 storey mall, and its gross area of over 35,000 m^2 accommodates 164 executive hotel apartments, with over 9000 m^2 allocated to various associated and support services.

The office tower is 294 m tall, and its gross area of 99,000 m^2 is distributed over 55 storeys. About 45,000 m of this area is lettable office space. The total parking provision of over 1700 cars is distributed over multi-level basements beneath the mall, and two parking structures.



Design Highlights

The scale of each of its main components is impressive. The 294 tall office tower is a visually striking and offers exceptional views of the downtown, and Kuwait Bay. Its form gives a sense of coherence with other major structures in the development's urban vicinity.

The powerful definition of entrances become inviting attractions in the public realm, and the complex's dynamic and organic massing with large white coloured elevation panels, enhances the overall visual impact.

The huge 300m long atrium, cavernous 7 storey open space, is a powerful design attribute as it weaves its way through the entire site like a river, with the linear patterning of floor reinforcing this effect. The sprawling skylight that caps this enormous space also strengthens the visual connectivity between the seven levels of retail accommodation.

sustainably designed advanced electro-mechanical systems, all comprehensively monitored by integrated environmental control mechanisms.

The demand of 11,700 tonnes of refrigeration is supported by 11 cooling towers and thermal energy system, and the entire development is served by all statutorily and functionally mandated public health and life and safety previsions, comprehensive and conveniently located vertical transportation installations, as well as building automation and management systems. The total power demand of the development is 43 MW, and as would be expected the electrical systems comprise main and emergency power supply; low voltage systems; state of the art ICT infrastructure and technologies; internal and external lighting control systems; advanced security, surveillance and access control systems; as well as various other special systems.

Assima is indeed an impressive mixed-use development and it has already become a popular commercial destination.

Engineering Systems

A sophisticated combination of structural and sustainably designed services engineering systems complement the design of the complex.

In terms of structural design, the tall office tower has an overall slenderness ratio of 9:1, and 17:6 for its core. The required lateral stability was archived with composite steel and concrete columns, with hefty double height steel outriggers at levels 23 and 43.

A biaxial voided slab system substantially reduced the building's mass and in turn its carbon footprint. Advanced soil analysis helped rationalise the sizes and number of piles. The irregular podium geometry was achieved with slanted columns, with steel bridges spanning the large interior voids.

The complex geometry of the hotel necessitated the introduction of a transfer structural system. The complex incorporates an extensive array of

Awardees

DEVELOPER:
Salhia Real Estate Company

DESIGN AND SUPERVISION CONSULTANTS:
PLP Architecture, England
PACE Architecture, Engineering & Planning, Kuwait

GENERAL CONTRACTOR AND MAIN CONCRETE SUPPLIER:
Ahmadiah Contracting and Trading Compa

Award of Achievement 2022

The Award of Achievement recognises an individual's longstanding contribution towards advancing the engineering profession, education, concrete usage and practice, construction technology, general development in Kuwait or excellence in a related area of research and expertise.

At its annual Awards Banquet held on 9th May, 2023, ACI-Kuwait Chapter proudly presented it's Award of Achievement for Year 2022 to a distinguished professional who established and oversaw the growth of one of Kuwait's oldest and largest consultancy practices.

Mr. Hamad Thunayan Alghanim (1938 - 2007)

1962, Abu Bader presenting Kuwait's new constitution to His Highness the Amir of Kuwait, Sheikh Abdullah Al-Salim Al-Sabah

The Awardee and Citation

ACI-Kuwait Chapter was pleased to present its ACI-Kuwait Chapter was pleased to present its Award of Achievement for Year 2022, and to posthumously honour Mr. Hamad Thunayan Alghanim, for his lifetime dedication and commitment to the engineering profession in Kuwait, to promoting ethical standards in professional practice, and selfless service to humanity'.

'Abu Talal', as he was respectfully known to everyone, was absolutely dedicated and committed to the engineering profession in Kuwait, and right up to the time he sadly passed away in May 2007, he promoted ethical standards in his life and work, and devoted himself to service to humanity. Understated intelligence and humility were his special attributes and his distinguished career was characterised by professionalism; integrity; ethics; scholarly pursuits, and charity, he was also a devoted family man, sportsman and poet.

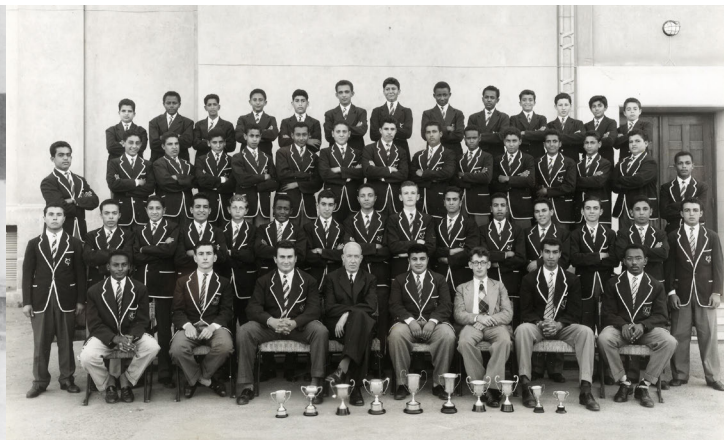
Education

Abu Talal was born in Kuwait in 1938. His was a well-known merchant and politically active family, and pictured below is Abu Talal's father, Mr. Abdulatiff Thunayan Alghanim, better known as Abu Bader, presenting Kuwait's new constitution to his Highness the Amir of Kuwait, Sheikh Abdullah Al Salim Al Sabah. The year was 1962. Early in his life, however Abu Talal decided that he would shy away from politics and trade, and pursue a professional career. Early schooling was at the Ahmadi School in Jibla Area. Primary schooling in Kuwait was followed by boarding school in Egypt, when as an 11 year old he joined the highly reputed and prestigious Victoria College in Alexandria.

Victoria College was at that time the most British of educational institutions. It instilled in him a deep sense of discipline and gave him a solid foundation in two languages, English and Arabic. Abu Talal's excellent command of both languages was always admired and appreciated by everyone who knew him.

'O' levels at Victoria college was followed by high school in Wales in UK, where he successfully completed his A-levels. It was then time for university. The story goes that he told the career advisor at Kuwait Embassy in London that he was keen on studying architecture. But judging from a sketch he asked Abu Talal to draw, the unimpressed advisor promptly decided that Abu Talal should become a civil engineer instead. He sent him to Queen's University in Belfast, Northern Ireland.

Ahmadi School, Jibla



Victoria College, Alexandria.

Queen's University, Belfast, 1960 - 1962

After two years of suffering the cold, however, he yearned for more pleasant weather and the choice was a move to University of Arizona in Tuscon. Three years later, in January 1965, he graduated with a B.Sc. Degree in Civil Engineering.

Career

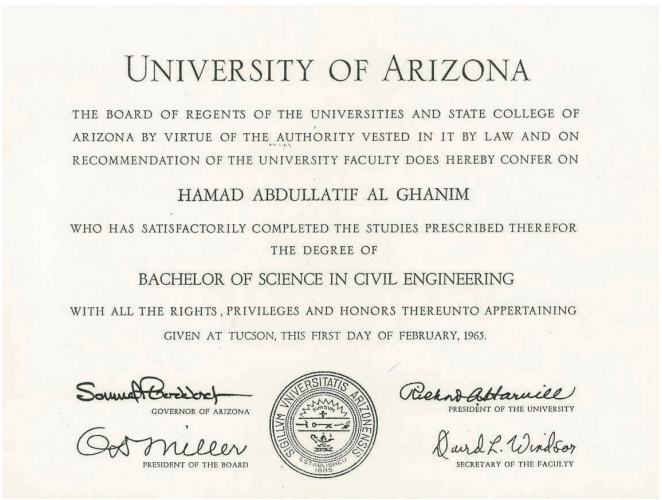
His first job as a fresh graduate back in Kuwait was with Kuwait Municipality's Building Department. Within a few months he decided he wanted more hands on experience, and MPW offered that opportunity.

In July 1965, he joined MPW's Design Department as a structural engineer. Promotion came within a year and he became Assistant Head of Design Department. Mid 60's and onwards was a time when Kuwait was riding on the cusp of optimism, pursuing new ventures and embarking on a programme of major developments. Opportunities were beckoning, but there certainly was a dearth of full-fledged Kuwaiti consultancy practices in the private sector. In search of a more challenging career, Abu Talal boldly decided to move to private practice. In 1967, with an architect friend of his he started Gulf Engineering Office, a humble start-up with a staff of only 5 people. By 1970 the number had increased to 10 and they moved to the Thunyan Alghanim Building near Sheraton Roundabout, and with it commenced the gradual process of building his reputation. Although his early projects were manly private houses, small apartment buildings and a few turnkey design-build developments, he was more importantly becoming known as man of integrity, someone who could be trusted. It is not surprising that some of his most endearing client relationship were built in those fledging years.

Change and Growth

Early 1970s ushered in an era of fast and drastic changes, when upheavals in the world's oil market impacted the pace of growth in all Gulf Countries.

Abu Talal's projects started becoming more complex and larger, sectors of operation widened, and he was becoming involved in many projects which were of national significance.



UNIVERSITY OF ARIZONA

THE BOARD OF REGENTS OF THE UNIVERSITIES AND STATE COLLEGE OF ARIZONA BY VIRTUE OF THE AUTHORITY VESTED IN IT BY LAW AND ON RECOMMENDATION OF THE UNIVERSITY FACULTY DOES HEREBY CONFER ON

HAMAD ABDULLATIF AL GHANIM

WHO HAS SATISFACTORILY COMPLETED THE STUDIES PRESCRIBED THEREFOR THE DEGREE OF

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

WITH ALL THE RIGHTS, PRIVILEGES AND HONORS THEREUNTO APPERTAINING

GIVEN AT TUCSON, THIS FIRST DAY OF FEBRUARY, 1965.

GOVERNOR OF ARIZONA

PRESIDENT OF THE BOARD

PRESIDENT OF THE UNIVERSITY

SECRETARY OF THE FACULTY

University of Arizona, Tucson, 1962-1965

Ministry of Public Works, Kuwait, 1965

More critical, however was the shift in Abu Talal's focus. While he did pursue private sector work, his interest was primarily in projects for the State of Kuwait.

That remained his professional focus, one in which throughout his life he wanted himself and his office to excel. His interest in serving Kuwait was apparent in everything he did, and family and friends always remember the mantra he often repeated "if there is anything good I have to do, I want to do it in Kuwait".

Gulf Engineering Office

In 1983, Gulf Engineering Office was renamed Gulf Consult, a change that also reflected the diversity of work and the addition of more disciplines to his practice. Also by their very nature many state level and large projects needed specialists and international participation, and to these renowned consultants, Abu Talal was always a trusted friend and reliable local support. He committed himself and his practice to giving them complete and high quality professional support.


GULF ENGINEERING OFFICE

PLANNERS, ARCHITECTURAL CONSULTANTS

HAMAD T. AL-GHANIM

PARTNER

P. O. Box 13025
Kuwait

Tel. Home 547538
Office 434158
420468

Their dues were always paid on time, even if he had to do so from his own resources. The fact that these international consultants still maintain and repeatedly seek association and participation with his firm, is testimony to his lasting legacy of fairness.

The immediate aftermath of the invasion of Kuwait in 1990 was understandably a stressful time for everyone in the country, but soon after the liberation Abu Talal back in Kuwait at Sheikh Saad's invitation. He had returned with a team of engineers to as help with the reconstruction effort. They worked with the American Army. This wasn't the most comfortable of times, and staying in a hotel with packaged dry food, and not having electricity, did not help!

Post Liberation

Gulf consult restarted operations in September 1991, and with it came more concerted attention to Kuwait, with a focus on public sector projects.

The nature of projects reflected this dedication to consolidating his effort and practice in Kuwait. The Firm's portfolio comprised large scale planning, medical, educational, institutional and national infrastructure projects. And with this diversity and quality of work, Abu Talal's standing and reputation in Kuwait's engineering and consulting fraternity continued to grow.

Gulf Consult

By 2004, his office had grown to over 600 staff, and his name had become synonymous with professional ethics and fairness in his dealings with clients, colleagues and staff alike. He inculcated a stress-free culture amongst his colleagues and staff, many remaining with him for decades. Everyone respected him for who he was.

Gulf Consult 2004

May, 2007

Sadly, on 26th May 2007, after the usual daily lunchtime get together with his Board of Directors, Abu Talal unexpectedly and peacefully passed away in the afternoon.

He will always be fondly remembered as “a Gentleman and a Scholar”, a phrase he often bestowed on those whom he considered to be worthy of it.

He was a very well read, had an astute mind, and up to end he worked a full day. His honesty, selfless humility and charitable work were remarkable, and his kind and humble demeanour obviously made him a very likeable person.

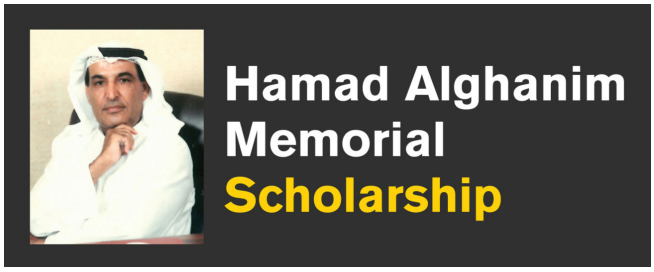
Personal

Outside work, Abu Talal was a man of many interests and pursuits. He greatly enjoyed poetry, which he also wrote.

He read voraciously and loved sports, playing squash till late in his life. The sea and fishing gave him considerable pleasure. He supported Gulf Consult’s cricket team and sponsored a national league in Kuwait. A daily walk was almost an addiction!

A devoted family man, he is survived by his wife, Ms. Laila Alghanim, four children and five grandchildren. His eldest daughter, Najla, is now the Chairman of Gulf Consult.

In memory of their father, and his keen interest in education they have established the Hamad Thunayan Scholarship Programme, which pays university fees for deserving children of Gulf Consult’s employees.



ACI-KC Technical Activities

A number of technical activities were carried out during 2023. These included seminars and presentations; as well as webinars which were conducted in association with American Concrete International.

Project Presentation

Dr. Nasser Abdulhassan of AGI Architects, one of MENA regions leading architects who is recongnised as being amongst the most outstanding architects in the Middle East, gave a presentation on their "Opportunity Pavilion" project that was developed for Dubai's Expo 2020.

Concrete Cracking

On 1st May, 2023, ACI-Kuwait Chapter, in association with ACI International, hosted a well-attended webinar on 'Concrete Cracking'. Dr. William Gold, PE, FACI, gave an interesting and informative presentation on the technical aspects of concrete cracking and applicable remedial measures.

Often, the key to addressing cracking is learning how to properly determine the cause of the crack, so that it can be mitigated and prevented in future projects.

Topics covered in Dr. Gold's presentation included:

- Causes and Control of Cracking
- Evaluation Methods
- Mitigation
- Crack Repair

More than 80 persons registered for this webinar, most of which were from Kuwait. The presentation was followed by a raffle and one of the Kuwait Chapter attendees had the opportunity to select one of the three differenct prizes worth up to $799.

Concrete Sustainability and Resilience

On 20th November, 2023, ACI-KC Technical Committee organized a webinar under the auspices of the popular Chapter Talk Webinars Programme

Dr. William Gold

Dr. Moetaz El-Hawary

of ACI International. The webinar was presented by Dr. Andrea Shokker, Chairperson of ACI 319/ACI 318T Committees, and Head of Civil Engineering Department and Provost of University of Minnesota, Duluth. Dr. Moetaz El-Hawary, Past President and Chairperson of ACI-KC's Technical Committee moderated the webinar.

Dr. Shokker's presentation provided an overview of low carbon concrete and addressed aspects such as sustainability and resilience specific to the concrete industry.

Topics included terminology and acronyms; state of the practice; future expectations; legislation and resources. The over 62 engineers who attended, most from Kuwait, thereafter participated in a post-webinar raffle in which they had the opportunity to win three prizes worth almost $ 800.

The webinar, being an important part of Kuwait Chapter's technical programme, was a useful opportunity for members and other attendees to improve their understanding about sustainability and resilience of concrete structures in Kuwait.

Collaboration with the MPW

In pursuance of its mandate to disseminate relevant information to engineers and facilitating continuing veducation, ACI-KC proposed a programme for seminars to be delivered to engineers of Ministry of Public Works.

Through the rigorous efforts of Ms. Dana Drobiova, Chairperson of the Chapter's Social COmmittee and Eng. Eman Al-Omar, Undersecretary of Government Center Sector in MPW, the proposal was approved by MPW. Two presentations have been delivered to date. On 26th November, 2023, Dr. Khaldoun Rahal gave a lecture on 'Frequency of testing on site; and testing for evaluation using cores'.

This was followed the next day by Dr. Moetaz El Hawary's presentation on 'Sustainability and Durability of Concrete Structures'

ACI - KC Students Committee

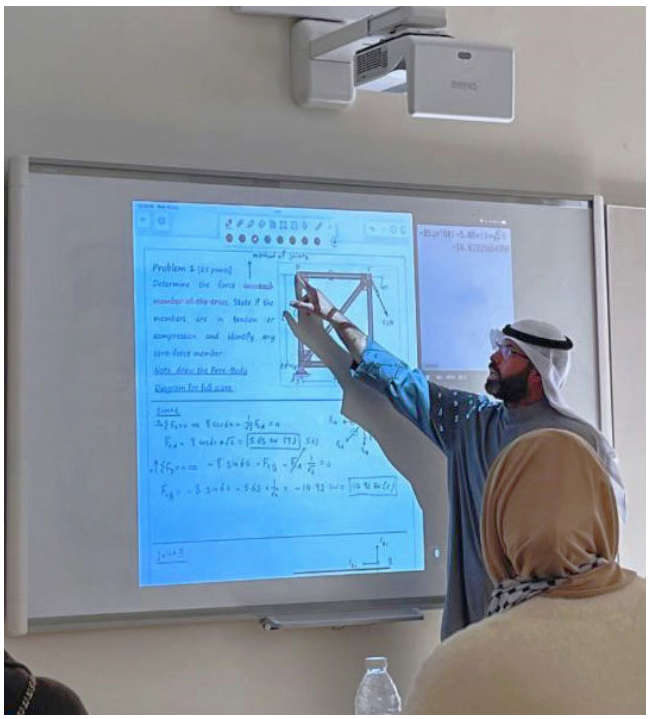
The ACI - KC Student Chapter at Kuwait University is part of the network of more than two hundred student chapters around the world. The Kuwait University Chapter aims to help its members develop leadership skills, increase concrete knowledge, and networking camaraderie.

Lecture on Statics and Strengths of Materias

The Chapter initiated its activities for the current academic year by organizing two revisions lectures to help students prepare for the exams.

The lecture on the Statics course was conducted by Dr. Abdullah Sulaiman Almutairi, who is an Assistant Professor at Kuwait University and a member of the ACI Kuwait Chapter. The lecture on the Strength of Materials course was conducted by Dr. Fares Abdullah Aljeeran, who is an Assistant Professor at Kuwait University. In total, about 70 students attended the two events. The Administrative Committee for the academic year 2023-2024 consists of the following students and future civil engineers: Raeda Sami Sobh (President), Anwar Hamidi AlKhaldi (Vice President), Lora Bandar AlRashedi (Treasurer) and Khalid AlRajhi (Secretary).

Their faculty advisor is Professor Khaldoun Rahal, who is also a member of the ACI-Kuwait Chapter.



Profile

Life, Career and Thoughts
ACI-KC President 2023-2024 : Mr. Ghassan Al-Ghawas

The Start

In early 1940 Kuwait started requesting Arab medical practitioners and other professionals to come here to build the new country., Upon receiving a formal invitation to join the medical team, Mr. Ghassan Al-Ghawas's father came here from Syria to practise as a pharmaceutical compounder. After years of outstanding service and a growing reputation, he was offered Kuwaiti nationality under Article 5 of the new 1959 Citizenship Law. They were living in the Sawaber area of the old downtown of Kuwait City, and in March 1960, Mr. Ghassan Al-Ghawas was born at home in a birth facilitated by an MOH appointed mid-wife.

His educational journey started with Tarek Kindergarten in Kuwait City, and when the family accepted housing land in Rumaithiya and built a beautiful house there, he joined Al Neel Kindergarten. Elementary and secondary studies were at Abdullah Al Dahiyan School and Palestine Elementary School respectively; and schooling was finally completed at Rumaithiya High School.

A scholarship then took him to St. Paul, Minnesota in USA, where his foundation course was completed in half the allocated time. The search for a university offering a degree in 'Architectural Engineering' was also an unusual saga, because the 12 universities he had applied to were unfamiliar with such a course. Thankfully, Iowa State University proposed Architecture as an alternative, and it is from there that he graduated in 1985 with his Bachelor of Architecture degree. The university also nurtured his passion for design.

Kuwait Municipality

On his return home a friend encouraged him to join Kuwait Municipality, and thus began a successful 13 year career, with progressively more responsibilities. He began in the Municipality's Building Department, and soon progressed to join the Chief Engineer's

office team. The Chief Engineer was one of the three undersecretary level positions under the Chairman of the Municipal Council.

Shortly after he had joined Kuwait Municipality, Kuwait Engineering Office were awarded a district planning project and Bou Yousif, as he is fondly known to everyone, was assigned to them as a trainee for a year. This gave him valuable insight into private practice, but as he did not want to lose out in career growth he returned to Kuwait Municipality.

In 1987, while still in the Chief Engineer's Office, Bou Yousif joined the Special Projects Permitting Committee (Lajnat Al-Ta'aba AlKhaas), which was headed by the Chief Engineer and comprised heads of the Municipality's Planning, Building, Inspection and Fire Departments. This was in effect a powerful committee that was mandated to give final approvals

and issue building permits after interim review comments are received from Fire, Planning and Building Departments. Bou Yousif became the Secretary of this Committee, and soon developed a keen interest in the building code.

Building Code

At that time well established developers were influencing building regulations and standards, and as such there was an obvious need for a more formal reference document that would serve as a definitive guide. The building code became his passion and he re-wrote in a digital format the regulatory schedules for permitting. His document remained in use for over 10 years, and it still forms the basis of the Municipality's current regulations.

As his reputation for integrity and authority was growing, it was no surprise that the Manager of the Building Department requested the Chief Engineer to bring Bou Yusuf back to the Building Department. He had to move, albeit a little reluctantly, but he soon became Head of the Governmental and Special Projects Selection (Al-Ta'aba AlKhaas), a position he held till 1998. An interesting highlight during this period was a trip to Beijing with the then Chairman of Municipal Council. China kindled his appreciation of what hard work can help achieve.

At work, however, some disillusion were beginning to set in, particularly with the casual attitude of some colleagues towards their responsibilities. He was also concerned that young graduates were not making the effort to learn from their very competent Kuwaiti mentors and knowledgeable expatriates. Bou Yousif was also critical of decision makers not willing to take bold and responsible steps, because he himself never hesitated to state his mind if he felt it was in the best interest of projects without undermining the interest of public domain.

Private Sector

Thereafter, when Mr. Ahmad Jihayem, Owner and Founder of Al Jazera Consultants (AJC) suggested that he should consider moving to private practice, he agreed to take the challenge. He joined the office as Assistant General Manager, and a candid admission about his time at AJC reflects Bou Yousif's honesty and professional integrity. By not having climbed through the ranks, and not being too conversant with the process, relationships and modus operandi of private practice, he felt that he had to exert double the effort to become as effective as he should be in that position. Furthermore, the long hours and constant involvement at work were certainly affecting the quality of his family and social life.

A few years later United Real Estate Company (UREC), offered him the opportunity to become Director of Development Sector, which involved initiating and managing interesting and exciting large scale developments. Bou Yousif joined UREC, managed their Kipco Tower project, and lead the venture for a huge mall in Salalah, Oman. Interestingly too, he headed UREC's consortium that started work on a major bid for the BOT development of the 33 Km2 Failaka Island, a project that was eventually shelved. In 2008, he moved on and joined Al-Bilad Real Estate Investment Co., as Vice CEO for Development.

As economically this was not the best of times given the dearth of projects in Kuwait, the Company pursued work in Oman, where a huge new downtown mall commissioned by the country's higher authority became his main focus. He was so involved in this development that spread over 3.0 Km2, that even after leaving Al-Bilad Company, he continued with the project on his own. Without a credible partner, however, the government did not permit him to continue, but he is proud that his master plan became the conceptual basis for what ultimately got built. Eventually, however, the urge for professional independence took hold, and in 2012 Bou Yousif became a freelancer.

Freelancing

The valuable experience of these few years reinforced his understanding of how to manifest his visions, start projects and strengthen his management capabilities.

Freelancing involved various projects and different clients and continued till 2018, when Mr. Ahmad Jihayem invited him back to Al Jazera Consultants as Deputy General Manager. He is still with AJC, and beside his main managerial responsibilities, he is directing and managing with his core team their mega Health Campus project for Kuwait University's Sabah Al Salem University City in Shadadiya.

In June last year he was elected President for American Concrete Institute - Kuwait Chapter for the year 2023-2024.

Career Reflections

In discussing his career and his reflections on professionalism, life and social issues, Bou Yousif had interesting things to say. His elevated positions in private companies allowed him to indulge his passion for design and influence creativity. But he admits to a challenge, in that to succeed as a leader one has to be confident, know the design process well and appreciate the balance between finance and creative sense.

The public sector came with the power of authority, which was reinforced by the good feeling of being able to do both, impose codes and controls, and contribute to the success of projects. Real estate taught him business and the intricacies of dealing with financially powerful companies and their large projects. It also allowed him to experience government agencies from the other side, and he now understands better the two sides of consultancy practice.

Bou Yousif strongly believes that statewide urban planning visions and mega developments can only be effectively manifested by a well-managed dictatorial system. Bureaucratic and consultative management invariably hamper quality and implementation, inevitably resulting in higher costs and delays.

Influences

Referring to design and architectural influences, Bou Yousif touched on the dilemma between the quest for respecting tradition and the 'old'; and the creative freedom that contemporary systems, materials and technology advancements offer. He cited examples from his days at the Municipality when many developers shunned the so called discomfort of old times and insisted on wanting everything modern. To him if the vernacular and traditional environments will not make people happy, one should be willing to compromise.

Ultimately though, there is no straight forward answer. Designers are always being asked to understand what people want, and judiciously exploiting technology may be the answer for achieving this. Style too would then become more international in nature, and this combination would not be bad for the environment. The emphasis, however, should be on a comprehensive building code that is enforceable and adaptable so as to keep pace with these advancements. Finally and importantly, he insists that authorities that oversee the application of the code have to be strict, yet fair.

Personal

Bou Yousif lives in his lovely home in Jabriya with his family. He enjoys spending time with his four children and two grandchildren, especially in their luscious roof garden and fireplace. He is particularly proud of his close relationship with his brothers and always looks forward to their traditional weekly gatherings. He enjoys travel, exploration, music and arts.

Bou Yousif was talking to Azizz Mamuuji, past President (2022-2023) of ACI-Kuwait Chapter.

ACI-KC Site Visits and Social Activities

ACI - Kuwait Chapter's Social Committee arranged visits to two major construction projects in Kuwait.

Assima Tower

On 14th January, 2023 , ACI-Kuwait Chapter organized a visit to the construction site of Assima Tower. The attendees were welcomed by Eng. Ehab Asham, the Construction Manager of Ahmadiah Trading and Contracting Company (ATCC). He commenced the visit by giving an informative presentation on the design and technical aspects of the building under construction. This was followed by a comprehensive tour of the tower.

The Social Committee of the Chapter wishes to thank Ahmadiah, the Main Contractor, and Pace, the Design Consultants, for giving our members the opportunity to visit this interesting construction site.

Al Shaheed Park Phase 3

Under the auspices of Al-Diwan Al-Amiri, members of ACI-Kuwait Chapter visited the construction site of Al-Shaheed Park (Phase 3) on 11th March, 2023.

The exciting urban park project, with a built-up area of over 220,000 m^2, comprises a wide variety of outdoor and indoor active and passive recreation components.

An iconic architectural highlight is the 2500 seat theatre which is one of the largest in the region. Some other major facilities within Phase 3 include an ice-skating rink, snow park, outdoor parkour and sky trail, outdoor skate and BMX park and indoor skydiving.

ACI-KC wish to thank the Amiri Diwan for facilitating this interesting and informative visit.

Annual Dinner

ACI-KC's Annual Dinner for 2023 was held on 11th December at Marina Hotel. The function commenced with a welcome address by Ms. Dana Drobiova, Chairperson of the Social Committee, and this was followed by a brief speech by Mr. Ghassan Al-Ghawas, ACI-KC President 2023-2024.

The speeches were followed by a 'Memory Game' and prizes were distributed to the winners. The evening concluded with Ms. Drobiova wishing eevryone well for the New Year and, of course a great buffet dinner.

Minimizing Risk: Portland-Limestone Cement Concrete Slabs

Best practices and strategies to reduce floor slab finishing and early-age, strength-critical challenges

While many contractors have successfully placed and finished concrete slabs constructed using Type IL cement (portland-limestone cement [PLC]), others have struggled with project delays and unacceptable finishes. To find the root causes of unsuccessful outcomes, jobsite data such as mixture proportions, weather conditions, construction practices and equipment, and finish requirements must be evaluated.

This article discusses early-age, strength-critical construction operations such as saw cutting, cold weather protection, post-tensioning, and form removal, as well as best practices and strategies to minimize risks during floor slab finishing and early-age, strength-critical construction. This article also provides data collected on six mockups constructed with Type IL cement and one mockup constructed with Type I cement.

The authors encourage others to share their data and experiences with Type IL cement.

Concrete Finishing Challenges

The outcomes of concrete slab placements are highly dependent on the mixture constituents and the fresh concrete properties such as slump, air content, bleeding rate, and setting time. The sensitivity of the fresh concrete to the environment impacts the finisher's techniques and timing to produce a quality product. One major factor that separates slabs requiring a trowel finish from slabs designed as paving1-4 is the length of time the fresh concrete slab is exposed to the environment. For slipform paving, Poole5 indicated that final finishing is usually completed within a few minutes of placing the concrete, well before the time of initial setting and the end of the bleeding period. For slabs to receive a trowel finish, final finishing may occur 3 to 8 hours after placement, with the longest delays occurring in cold weather with high relative humidity. This extended exposure time poses a substantial risk to contractors who are tasked with turning a sensitive, perishable product into a quality hardened product for the owner. Thus, slipform paving and parking lot examples are not comparable to slabs specified to receive a trowel finish.

Survey on PLC Concrete

The recent Joint ACI-ASCC Survey on PLC Concrete (to be published in the February 2024 issue of *Concrete International*) posed questions to elicit user experiences with finishing and performance of slabs requiring a trowel finish. The percentages reported in the following section represent the answers from 173 respondents. As the survey shows, fresh concrete properties changed when the cement changed.

Reported changes in fresh concrete properties associated with changing from Type I cement to Type IL cement include:

- Water demand—77% reported an increase while 7% reported a decrease;
- Bleed water—14% reported an increase while 39% reported a decrease;
- Setting time—51% reported an increase while 21% reported a decrease;
- Crusting—31% reported an increase while 1% reported a decrease;
- Changes in finishing—45% reported an increase while 3% reported a decrease; and
- Need for evaporation reducer—38% reported an increase while 1% reported a decrease.

Reported PLC concrete performance characteristics (relative to concrete produced using Type I portland cement) include:

- Plastic shrinkage cracking—43% reported an increase while 6% reported a decrease;
- Scaling—13% reported an increase while 1% reported a decrease;
- Dusting—13% reported an increase while 1% reported a decrease;
- Wear resistance—4% reported an increase while 19% reported a decrease; and
- Delamination—17% reported an increase while 1% reported a decrease.

The Neuber Concrete Experience

Neuber Concrete, Phoenixville, PA, USA, was contracted to construct a 79,000 ft^2 (7340 m^2) tilt-up building including a slab-on-ground, casting slabs, and wall panels. The ready mixed concrete producer indicated that Type IL cement was the only option. Because this was Neuber Concrete's first experience with Type IL cement concrete, test slabs/mockups were used to evaluate the Type IL cement's effects on finishing. Ultimately, seven mockups were made. The ready mixed concrete producer and cement supplier made site visits during the mockups and provided recommendations. Bleeding observations, estimates of evaporation rates, and quality of the finished surfaces were recorded. While we have found no other published data correlating bleed water, evaporation rates, and surface finish with Type IL cement concrete, the Neuber experiences are instructive.

Mockup mixtures

The mixture ingredients and batch weights for the mockups are shown in Table 1. Mockup 1 had proportions of the typical concrete mixture used by Neuber Concrete. The mixture produced a slab that was good enough to use as a casting bed, but it was not up to the contractor's standards for a slab-on-ground because the bleeding rate did not offset the evaporation rate. The next five mockups were used to adjust the concrete mixture and initial curing methods to overcome this issue. For Mockup 7, the ready mixed concrete producer supplied concrete with a Type I cement.

As shown in Table 1, there were two attempts to increase the bleed water. The water content was increased by about 20 lb/yd^3 (12 kg/m^3) for Mockup 5, and a coarser sand with a higher fineness modulus was used.

Mockup parameters: The seven mockups included two for tilt-up panels at 3.5 in. (90 mm) thick and five for slab-on-ground 7 to 8 in. (178 to 230 mm) thick. The quantity of concrete ranged from 16 to 40 yd^3 (12 to 30 m^3), and the placement sizes varied from 600 to 3300 ft^2 (56 to 307 m^2). The mockups were placed in May and June 2023. Table 2 provides a summary of the measured data and observations for the mockup placements.

Table 1:
Specified properties and proportions of non-air-entrained mixtures used for mockup placements

Mixture properties and proportions	Mockup No.						
	1	2	3	4	5	6	7
Compressive strength, psi	4000	4000	4000	4000	4000	4000	4000
Design slump, in.	6.0 ± 1.0	7.0 ± 1.0	7.0 ± 1.0	6.0 ± 1.0	6.0 ± 1.0	6.0 ± 1.0	6.0 ± 1.0
Unit weight, lb/ft^3	152.5	151.6	151.6	152.5	152.5	152.5	152.5
Steel fibers, lb/yd^3	45	0	0	0	0	0	0
Cement type*	IL	IL	IL	IL	IL	IL	I
Cement, lb/yd^3	530	620	620	530	530	620	530
Water, lb/yd^3	265	283	283	265	275	283	265
w/cm	0.50	0.46	0.46	0.50	0.52	0.47	0.50
Maximum aggregate size, in.	1-1/2	1	1	1-1/2	1-1/2	1-1/2	1-1/2
Coarse aggregate, lb/yd^3	1684	1446	1520	1684	1684	1684	1684
Intermediate, No. 8, lb/yd^3	400	346	240	400	400	400	400
Fine aggregate, lb/yd^3	1224	1410	1385	1224	1224†	1224†	1224
Water-reducing admixture, fl oz/cwt	6	4	6	6	6	6	6

Notes for Table 1
*Cement mill certificates indicated limestone content and specific surface area (SSA) of 3.8% and 383 m2/kg for Type I cement and 13% and
488 m2/kg for Type IL cement
†Mockup 5 and 6 comprised a sand with a higher fineness modulus (coarser) than other mockups
Note: 100 psi = 0.7 MPa; 1 in. = 25 mm; 1 lb/ft3 = 16 kg/m3; 1 lb/yd3 = 0.6 kg/m3; 1 fl

Notes for Table 1
*Evaporation rate calculated using the Uno equation provided in ACI 305R-20
†Measured with Kestrel Concrete Weather Pro 5200L
‡Water comes up through cracks when troweled concrete surface is pushed down
§Good enough to use as a casting bed, not up to contractor standards for slab-on-ground
#Not good enough to use as a casting bed, removed and disposed off site
Note: 1 yd3 = 0.8 m3; 1 ft2 = 0.09 m2; 1 in. = 25 mm; °C = 5/9 × (°F – 32); 1 mph = 1.6 km/h; 1 lb/ft2/h = 4.9 kg/m2/h oz/100 lb = 65 mL/100 kg

Table 2:
Data for slab-on-ground (SOG) and tilt-up panel (Panel) mockups

Mixture properties	Measured data for mockup placements						
	1	2	3	4	5	6	7
Cement type	IL	IL	IL	IL	IL	IL	I
Placement date	5/10/23	5/15/23	5/19/23	6/5/23	6/8/23	6/16/23	6/29/23
Placement volume, yd^3	40	40	16	30	36	34	20
Placement area, ft^2	1890	3300	600	1400	1450	1421	1000
Placement thickness, in	7	3.5	3.5	7	7	8	7
Mockup type	SOG	Panel	Panel	SOG	SOG	SOG	SOG
Environmental factors							
Average air temperature, °F	65	61	63	65	55	61	72
Concrete temperature, °F	66	69	70	69	66	72	74
Average wind speed, mph	3	6	7	7	5	6	6
Average RH, %	60	54	57	50	57	80	66
Evaporation rate, lb/ft^2/h	0.03*	0.08*	0.09*	0.04 to 0.07*	0.02 to 0.09*	0.07*	0.06*
Fresh concrete properties							
Slump, in.	7.5	6.0	7.0	7.0	7.5	6.0	6.0
Air content, %	0.7	1.5	1.0	Not measured	1.1	1.3	1.5%
Bleed water sheen, visual	Little	None	None	None	Little	Little	Good
Observations during and after finishing							
Plastic shrinkage cracking	Yes	No	No	Yes	No	Yes	No
Surface tearing	No	Yes	Yes	Yes	Yes	Yes	No
Surface cracking	No	Yes	Yes	Yes	Yes	Yes	No
Crusting	No	Yes	Yes	Yes	Yes‡	Yes	No
Spotty setting	No	Yes	Yes	Yes	Yes	Yes	No
Delamination	No	No	No	No	No	Yes	No
Contractor's overall rating	OK§	Bad#	Bad#	Bad#	Bad	Repair needed	Great

Fresh concrete properties: Slump and air content were measured. Slumps ranged from 6.0 to 7.5 in. (152 to 190 mm), and air content ranged from 0.7 to 1.5%. Bleed water sheen was visually observed—none, little, or good. Fresh concrete properties are reported in Table 2.

Environmental factors: Table 2 summarizes the measured material and environmental conditions during concrete placements. Air and concrete temperature, relative humidity (RH), and wind speed were recorded. A Kestral Concrete Weather Pro 5200L was used to collect data and report evaporation rates on Mockups 4 and 5. The evaporation rate on the other mockups was calculated using the Uno equation provided in ACI 305R-20.[6]

Placement and finishing: All placements were executed using the following steps:

- Place—concrete was deposited directly from the chute of the concrete truck onto polyolefin sheeting;
- Strike off—concrete was leveled using a wheel-mounted, laser-guided screed;
- Wait—workers observed the concrete until bleed water and time of setting indicated finishing could commence;
- Float—concrete was worked using pans on a double-rider trowel machine; and
- Trowel—concrete was finished using combination blades on a double-rider trowel machine.

Initial curing methods and evaluation: No initial curing methods were used for the first three mockups, as this was not typically needed with Type I mixtures under the conditions at the time of placement. Because plastic shrinkage cracking, surface cracking, and crusting were observed on the first three mockups (even though evaporation rates were low), water misting and evaporation reducers were used on Mockups 4, 5, and 6. Table 3 provides the initial curing methods and the contractor's evaluation of the results. Evaporation reducers are water-based emulsions that slow evaporation rates by forming monomer films and compensating to a small degree for water lost due to evaporation.

Surface evaluation during finishing: Figures 1, 2, and 3 show examples of plastic shrinkage cracking, surface tearing, and surface cracking observed on Mockups 4, 5, and 6. The occurrence of these issues and the contractor's overall evaluation of the finishing are provided in Table 2. Crusting was evident in most of the Type IL cement concrete mockups. The crusting was evident as water was pushed to the surface of the slab when finishers applied pressure on the slab. Only Mockup 7, the slab constructed with Type I cement, was given a good rating by the contractor.

Project construction: The project was successfully constructed with Type I cement.

Bleeding Rate and Capacity, Evaporation Rate, and Setting Time

Poole[5] indicates that loss of water due to evaporation is particularly critical during the initial curing period. Under climatic conditions favorable to drying, evaporation of bleed water can be quite rapid. When evaporation exceeds bleeding, the near-surface zone of the cement paste dries, resulting in shrinkage and development of tensile strains. Because tensile strength at such early ages is very low, fresh concrete develops plastic shrinkage cracks.

Thus, a finisher's most critical objectives are accurately anticipating the evaporation-to-bleed water balance and taking adequate steps to shift that balance to a favorable position. Current guidance suggests either limiting the time concrete is left in an unprotected condition or limiting evaporation rates.

Neuber's mockup information suggests a critical evaporation rate of about 0.05 lb/ft^2/h (0.24 kg/m^2/h)—identical to the allowable evaporation rate specified for silica fume concrete bridge deck overlays.[6] And Neuber's experience relates to a comment from the ACI-ASCC Survey: "…have to use evaporation retarder [reducer], no matter the evaporation rate." The use of an evaporation reducer, however, does not guarantee success. In the Neuber mockups, the application of an evaporation reducer did not result in adequate finishability or overall success.

Table 3:
Initial curing methods and contractor evaluation

Mockup No.	Initial curing methods	Contractor evaluation
1	No misting or evaporation reducer used	Some bleed water Surface OK
2	No misting or evaporation reducer used	Crusting, spongy, surface tearing
3	No misting or evaporation reducer used	Soft, spongy with hard surface
4	Truck 1: Applied evaporation reducer directly from pan machine on first pass Truck 2: Applied evaporation reducer from backpack sprayer directly after laser screed	No bleed water on any surface Crusting and cracking
5	1/4 area—no water misting or evaporation reducer 1/4 area—misted directly after laser screed strike-off 1/2 area—applied evaporation reducer directly after laser screed	Small amount of bleed water Not as effective as evaporation reducer Surface water longer than other areas but crusted and cracked
6	Applied evaporation reducer directly after laser screed with a power drum sprayer	Soft, spongy, and cracking
7	No misting or evaporation reducer used	Good amount of bleed water Finished great

Critical points during construction: Comparing bleeding behavior with probable drying conditions will identify potential critical periods prior to the time of initial setting. Figure 4 provides a hypothetical plot of evaporation and bleeding for a Type I cement concrete pavement placement.[5] For the first 1/2 hour, and again after about 4 hours, evaporation can exceed bleeding. The two periods, marked with red ovals, represent critical time periods for plastic shrinkage cracking. In the first critical period, the mixture will be plastic and can adjust to evaporative losses by shrinking into a thinner placement. However, cracking may occur during the second period because the concrete will have developed some stiffness and cannot adjust to the loss of water by simply reducing volume.

Figure 5 provides a hypothetical plot of evaporation and bleeding for Type I cement concrete pavement treated with an evaporation reducer shortly after strike-off.[5] The evaporation reducer shifts the cumulative evaporation curve, keeping the cumulative evaporation below the cumulative bleeding until final setting at 5 hours. This shift effectively eliminates any critical periods for plastic shrinkage cracking.

Figure 6 provides a hypothetical plot of evaporation and bleeding for a Type IL cement concrete slab placement treated with an evaporation reducer. Although the reducer shifts the cumulative evaporation curve, evaporation exceeds bleeding throughout the initial curing period. Such a scenario would expose the fresh concrete to conditions suitable for crusting and plastic shrinkage cracking. Both outcomes were observed in the Neuber mockups.

Bleeding rate and capacity: Poole[5] reported that 12 in. (300 mm) pavements placed using concretes with a water-cementitious material ratio (*w*/*cm*) ranging from 0.38 to 0.48 had bleeding rates ranging from 0.03 to 0.06 lb/ft^2/h (0.15 to 0.30 kg/m^2/h). These rates are much lower than those observed in slab-on-ground concretes. For slab-on-ground placements for mixtures with *w*/*cm* ranging from 0.47 to 0.52, for example, bleeding rates of 0.10 to 0.30 lb/ft^2/h (0.5 to 1.5 kg/m^2/h) were observed for a 6 in. (150 mm) thick slab.[7] Thomas and Hooton,[8] for study 2, reported that the mixtures without supplementary cementitious materials (SCMs) showed reduced bleeding for PLC compared with ordinary portland cement (OPC). In some mixtures with SCMs, no bleed water was observed.

Figure 7 illustrates the bleeding capacity of concrete with *w*/*cm* = 0.50 at a cement content of 350 kg/m^3 (600 lb/yd^3).[9] Mixture C0 was produced with Type I portland cement, and Mixtures C10 and C20 were produced using PLC. The bleeding rates of the PLC mixtures were about half that of Mixture C0. Because the PLC mixtures essentially stopped bleeding hours prior to Mixture C0, the total bleed water for the PLC mixtures was about 75% of the total bleed water for the portland cement mixture.

Tennis et al.[2] verified that the bleeding rate is influenced primarily by the specific surface area (SSA) and not necessarily the amount of limestone in the cement (refer to Fig. 8). While the authors conclude that "In general, there appears to be no concern with bleeding for mixtures containing cements with limestone,"[2] they fail to emphasize the sensitivity of bleeding rate to SSA. For example, the SSA values for the Type I and Type IL cements used in the Neuber mockup slabs (383 and 488 m^2/kg, respectively) correlate with bleeding rates of 7.3 x 10^{-4} and 17.8 x 10^{-4} cm/min (Fig. 8). Reference 2 would therefore indicate that the bleeding rate for the Type IL cement is less than half the bleeding rate for Type I cement.

As previously noted, data for bleeding rate of PLC concretes used for slabs-on-ground is scarce. Contractors are currently requesting data from ready mixed concrete producers. Neuber requested bleed data for both the PLC and Type I cement mixtures. While bleed data was not available for the mockup mixtures, Fig. 8 shows a significant effect based on the cement fineness. Further, the ACI-ASCC Survey showed that 39% of the respondents observed less bleed water with PLC concrete than with Type I portland cement concrete.

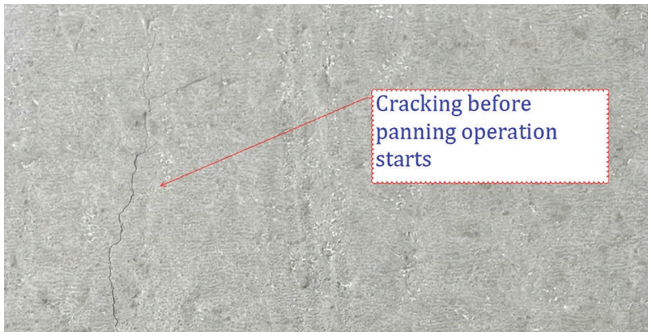


Fig. 1: Plastic shrinkage cracking prior to finishing operations

Fig. 2: Surface tearing during troweling

Fig. 3: Surface cracking during troweling operation, concrete below surface is still plastic

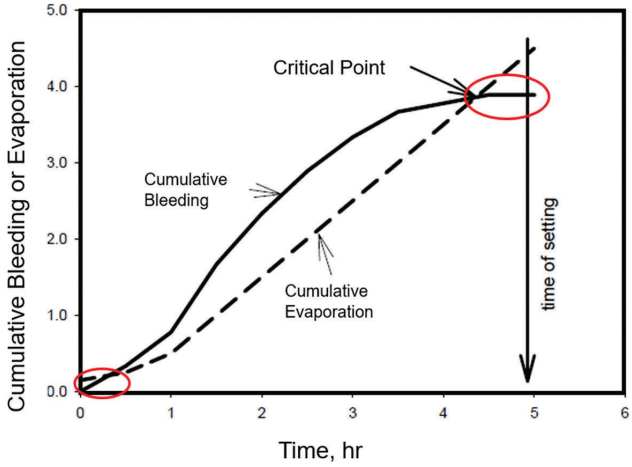


Fig. 4: Hypothetical plot of cumulative bleeding and evaporation versus time for a concrete mixture prepared with Type I portland cement. The red circles indicate critical periods in which evaporation exceeds bleeding (after Reference 5)

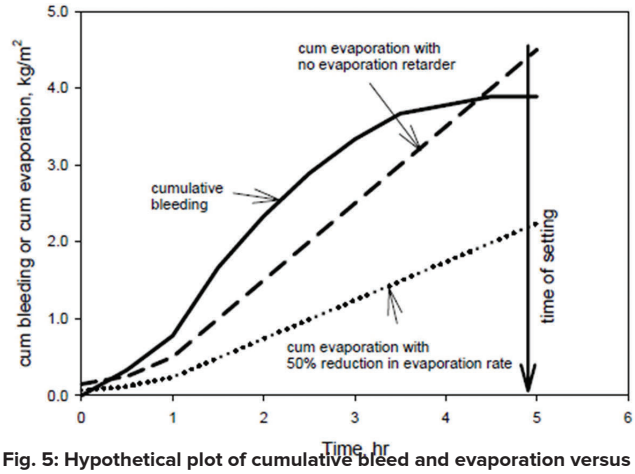


Fig. 5: Hypothetical plot of cumulative bleed and evaporation versus time for a concrete mixture prepared with Type I cement and finished using an evaporation reducer immediately after strike-off. By lowering cumulative evaporation, the surface treatment eliminates critical periods for plastic shrinkage cracking (after Reference 5)

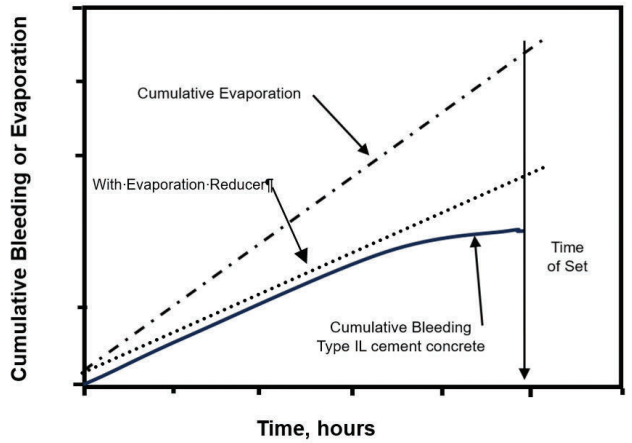


Fig. 6: Schematic plot of cumulative bleeding and evaporation versus time for a concrete mixture prepared with Type IL cement. Based on observations, the cumulative bleeding of PLC concrete is lower than the cumulative evaporation, even though a slab has been treated with an evaporation reducer. PLC concrete is therefore susceptible to plastic shrinkage cracking throughout the entire placement (after Reference 5)

Evaporation rate: ACI 305R-20 provides some advice on measuring evaporation rates. Many contractors, including Neuber, use Kestral weather stations that can calculate evaporation rates based on measurements of air temperature, RH, wind speed, and concrete temperature. It should be noted, however, that the provided rates are estimates based on a study of evaporation rates from a lake. Further, the estimates do not account for the significant effect of solar heat gain.[6]

Setting time: Many factors affect setting time. While the greater fineness of Type IL cement relative to Type I cement can reduce the setting time, SCMs will decrease the setting time. The setting time must therefore be measured for any new combinations.

Time of initial setting is important because it indicates when bleeding is complete and final curing procedures can be initiated. However, the time of initial setting measured by ASTM C403/C403M,[10] at a penetration resistance of 500 psi, is not the correct time to initiate final curing procedures. Bury et al.,[11] Suprenant and Malisch,[12] Lee and Hover,[13] and Dodson[14] showed that power floating should start at a penetration resistance of about 50 to 150 psi (0.3 to 1.0 MPa). Calorimetry per ASTM C1753/C1753M[15] can be used to estimate setting time, but the final curing time must be calibrated with the 50 to 150 psi penetration resistance.

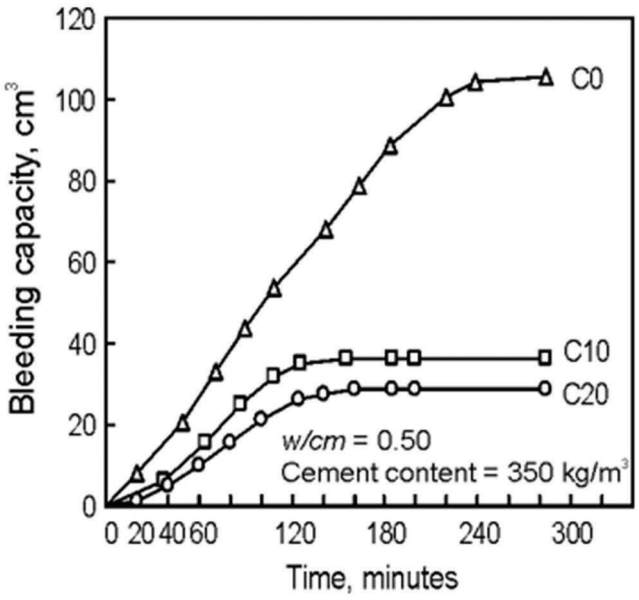


Fig. 7: Bleeding capacity of concrete with *w/cm* = 0.50 at a cement content of 350 kg/m³ (600 lb/yd³). One portland cement, C0, and two portland limestone cements, C10 and C20, were used.[9] Over the initial 120 minutes, the bleeding rates for concrete produced using C10 and C20 cements (with limestone) were about half the rate for concrete produced using C0 cement. Further, the bleeding capacity was reduced by about 75% (Note: 1 cm³ = 0.06 in.³)

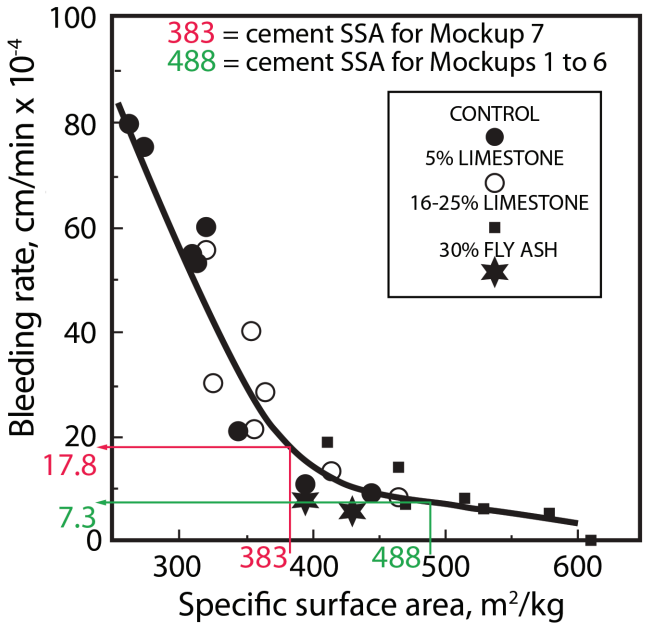


Fig. 8: The influence of specific surface area (SSA) of cementitious material on the bleeding rate (after Reference 2). We have indicated the SSA values (refer to Table 1) and associated bleeding rates for the cements used in the Neuber placements (Note: 1 cm/min = 0.4 in./min; 1 m²/kg = 4.9 ft²/lb)

Application and Effectiveness of Evaporation Reducers

A major difference between concrete slabs-on-ground and most other concrete structures is the large surface area-to-volume ratio. This makes slabs-on-ground highly susceptible to environmental effects such as drying or temperature extremes. Compounding this is the relatively large amount of such concrete that can be placed in a single workday, resulting in a large surface area that must be managed without delay. For example, based on owners' demands for cost and schedule, the current slab placement for an industrial slab is 40,000 ft² (1700 m²) that is exposed to prevailing climatic conditions. As a matter of economics, this amount of surface area strongly affects choices for initial curing methods and materials.

Access: A 40,000 ft² industrial slab would be roughly 275 ft long by 150 ft wide (84 m long by 46 m wide). Such large areas will allow only limited access for initial curing during the 3 to 8 hours the fresh concrete will be exposed to the environment. Figure 4 shows the critical point when cumulative evaporation exceeds cumulative bleed, which is when power trowels are on the slab. Modern power trowels are equipped with containers capable of holding about 5 gal. (19 L) of evaporation reducer. Based on a typical manufacturer's recommended average application rate of 300 ft²/gal. (7.4 m²/L), a trowel will have enough reducer to cover about 1500 ft² (140 m²) of slab area. For concretes produced using Type I cement, application of evaporation reducer using power trowels has worked well.

Wheel-mounted, laser-guided screeds provide another opportunity for applying evaporation reducer. A commonly used laser screed carries a 16 gal. (61 L) capacity storage container that can apply evaporation reducer at a rate of 150 to 450 ft² (14 to 42 m²), and the screed can apply reducer only at the start of the placement.

Multiple applications: Water (in the form of mist) or evaporation reducers can be used to prevent excessive loss of bleed water. Water application generally faces no serious specification compliance issues and may be a reasonable option when evaporation rates are such that one or two passes by the application equipment are sufficient to protect the concrete. Poole[16] reports that for an application rate of 0.04 lb/ft²/h (0.20 kg/m²/h) and an evaporation rate of 0.20 lb/ft²/h (1.00 kg/m²/h), water would need to be applied every 12 minutes to avoid loss of mixing water.

Evaporation reducers are a very practical option for extending this period between required applications. Depending on the conditions, multiple applications may be needed. Equation (1) yields a conservative estimate of the frequency of the application of an evaporation reducer for a given condition

$$F = \frac{AR}{ER(1-0.4) - BR} \quad (1)$$

where F is the frequency of application in hours; AR is the application rate; ER is the evaporation rate; and BR is the bleeding rate of concrete, with AR, ER, and BR in lb/ft²/h or kg/m²/h.

The constant, 0.4, is taken to be the reduction in evaporation rate caused by an evaporation reducer. Most manufacturers claim at least a 50% reduction in evaporation rate, so this equation is probably conservative. A commonly recommended AR is 0.04 lb/ft² (0.2 kg/m²), also expressed as 200 ft²/gal. (5 m²/L), and this rate is near the maximum that can be applied practically without ponding or runoff.

Effectiveness of evaporation reducers: As there is no standard specification for evaporation reducers, contractors must follow manufacturer's guidelines. A review of 14 evaporation reducers listed in AIA MasterSpec 03000 cast-in-place concrete[17] indicates that nine provide data on the amount of moisture reduction. However, the data these manufacturers provided for reduction in moisture loss associated with wind (80% reduction) and sunlight (40% reduction) were the values originally reported by Cordon and Thorpe in 1965.[18]

Poole[16] investigated three evaporation reducers in a limited testing program. Mortars were prepared according to ASTM C156,[19] and evaporation reducers were applied at the manufacturer's recommended rate 200 ft²/gal. (5 m²/L) immediately after molding. The specimens were then placed in a walk-in environmental room at 100°F (38°C), 30% RH, with a fan directed on the surface at a speed of 6.7 mph
(11 km/h). Specimens were weighed periodically, and evaporation rates were calculated. Control specimens had no evaporation reducer applied. The test ran for 2.5 hours.

Cordon and Thorpe[18] tested evaporation reducers in either wind or sunlight but not in combination. Poole[16] tested evaporation reducers with air temperature, RH, and wind—anticipated weather conditions in the field. Poole's test values are lower than those observed by Thorpe and Cordon, which is understandable due to the different

Table 4:
Effect of evaporation reducers on evaporation of bleed water from mortar specimens

Evaporation reducer	Mass loss, kg/m²/h		Evaporation reduction, %
	With evaporation reducer	Control	
Product A	0.58	0.75	23
Product B	0.49	0.88	44
Product C	0.42	1.19	65

Note: 1 kg/m²/h = 0.2 lb/ft²/h

environmental conditions. What is not understandable, however, is the range of the test results—23, 44, and 65% reduction in moisture (Table 4). In other words, not all evaporation reducers are equal. The best product was found to be two to three times better than the other two products. These are disturbing results for concrete contractors using evaporation reducers to minimize plastic shrinkage cracking and surface crusting. Some contractors indicate that water misting works better using an evaporation reducer—a plausible conclusion if the evaporation reducer they evaluated provided a low reduction in moisture.

From Poole's limited investigation,[16] it appears as though protecting concrete during the period between placing and applying final curing using evaporation reducers might require repeated applications, depending on conditions. This would particularly apply if the time of initial setting was several hours after placement, which occurs for slabs to receive a trowel finish.

The limited test results presented herein suggest a wide variation in performance among products. These products are in common use and potentially have a role to play in minimizing early drying problems for PLC concretes. Although the use of an evaporation reducer did not prove effective in the Neuber mockups produced using Type IL cement, it is clear that the industry needs to develop test methods and a specification for evaporation reducers.

Best Practices and Strategies to Minimize Slab Finishing Challenges

The following recommended processes, even though they don't guarantee success as the Neuber mockups illustrate, provide the best solution to minimize slab finishing challenges:

- During the trial batch process, acquire data from a bleed test in accordance with ASTM C232/C232M[20] and a setting time test in accordance with ASTM C403/C403M. For ASTM C232/C232M, obtain the bleeding rate and the accumulated volume of bleed water versus elapsed time. For ASTM C403/C403M, obtain the setting time for 150 psi penetration resistance. This information is needed to develop an initial curing plan for the mockup;
- Based on the anticipated weather, develop an initial curing plan using bleeding and setting time data. Evaluate options for access and techniques for spraying multiple applications of evaporation reducer. Use this plan on the mockup;
- Perform a mockup using the anticipated tools and techniques, and incorporate the initial curing plan. Some Type IL cement concrete mixtures are sensitive to environmental changes, so there is a need for mockups representing both cold (50°F [10°C]) and hot (90°F [32°C]) weather. Adjust the plan based on the mockup, and, if necessary, perform another mockup; and
- Because trial batch data and mockup information might not be available until after the contract is awarded, qualify bid proposals based on anticipated timing of finishing and initial curing. If the planned construction operations require more time, the concrete mixture needs to be adjusted to achieve desired bleeding and setting time, or the anticipated initial curing plan changes, a change order would be appropriate to cover the added costs.

Early-Age, Strength-Critical Concrete Challenges

Construction operations, and thus cost and schedule, are highly dependent on early-age concrete strength. Compressive strength requirements are specified for cold-weather protection (500 psi before first freeze and 3500 psi before multiple freezing-and-thawing cycles per ACI 306R-1621), stressing post-tensioning (2500 psi per ACI CODE-318-(19)22)[22], and form removal (75% f_c' per ACI 347R-14(21)).[23] Saw-cut joint timing is also correlated with compressive strength, depending on the aggregate type, ranging from 500 to 1000 psi.[24] Thus, any reduction in strength or delay in early-age strength gain can dramatically affect construction cost and schedule.

The recent Joint ACI-ASCC Survey on PLC Concrete posed questions to elicit user experiences with the performance of early-age concrete in various strength-critical construction operations. The percentages reported as follows represent the answers from 173 respondents. According to the survey, construction operations have been affected by difficulties in achieving early-age strength for PLC concrete.

The following construction operations were influenced by the early-age PLC concrete strength:

- Cold weather protection—49% reported changes;
- Post-tensioning—11% reported delays;
- Form removal—18% reported delays;
- Saw-cut joints—70% reported changes in timing; and
- Compressive strength—30% reported decrease at 3 days while 40% reported decrease at 7 days.

Cold weather protection: Risks include early freezing before concrete reaches 500 psi and multiple freezing-and-thawing cycles before concrete reaches 3500 psi (24 MPa). Low or delayed early-age strength increases the length of cold weather protection, increasing costs and delaying schedule.

Saw-cut joints: Risks include early sawing that causes joint raveling (Fig. 9) and late sawing that causes the concrete to crack outside the joint (Fig. 10). Joint raveling

makes it more difficult to fill joints, and the raveled edges may create an undesirable aesthetic. Cracking outside the joint may lead to crack repair or diminished load transfer. Figure 11[25] illustrates the sawing window for which contractors may need to adjust for some Type IL cement concrete slabs. ACI-ASCC Survey comments include: (a) "Some have seen cracking before early entry sawcuts could be cut," (b) "Intermittent setting and unpredictable set times of the concrete made timing the sawcuts difficult. Material sets faster in hot weather and slower in cold weather than equivalent I/II cement," and
(c) "There is a need to be very strict about timing for sawcuts."

Stressing post-tensioning: Risks include slab blowouts when stressing and cracking prior to stressing, both due to low strength. On one project, the ready mixed concrete producer told the contractor to use the same maturity curve for Type IL cement concrete as that developed for Type I cement concrete. As Fig. 12 illustrates, the maturity curve for Type I cement over predicted the strength for Type IL, resulting in slab blowouts during stressing; ACI-ASCC Survey comment: "Issue with accuracy of maturity meter readings at early stages of curing of air-entrained mixes with IL cement. Maturity meter readings overpredicted strength. Resulted in PT anchor blowouts. Utilized Windsor probes to assist in determination of concrete strength."

Form removal: Risks include cracking and increased deflection due to early form removal when concrete strength is low, and increased cost and schedule for delayed form removal due to low strength; ACI-ASCC Survey comment: "The last three (cold weather, stressing, and form removal) are most problematic and uniform across the Type IL footprint...reduced 18 hr to 36 hr strengths resulting in delayed post tensioning, form removal, and construction time.

■ Minimizing Early-Age Strength Challenges

Recommended best practices and strategies to minimize early-age strength challenges include:

- Develop a new trial batch for each Type IL cement concrete mixture, measuring early-age strength at 1, 3, and 7 days. Alternatively, develop a maturity curve on the trial batch in accordance with ASTM C1074.[26] Prior to performing strength-critical operations, such as formwork removal or post-tensioning, ASTM C1074 requires supplementing determination of concrete maturity with other tests;
- Ensure saw cuts are incorporated into slab mockups. Some Type IL cement concrete mixtures are sensitive to environmental changes, resulting in the need for mockups representing both cold (50°F) and hot (90°F) weather; and
- Because trial batch data and mockup information might not be available until after contract award, qualify bid proposals based on anticipated timing of cold weather protection, stressing post-tensioning tendons, and form removal. If the planned construction operations require more time or if the concrete mixture needs to be adjusted to achieve desired early-age strengths, a change order would be appropriate to cover these costs.

Fig. 9: Saw cutting too early results in raveled joint edges *(photo courtesy of Scott Metzger, Metzger/McGuire)*

Fig. 10: Saw cutting too late results in cracking *(photo courtesy of Scott Metzger, Metzger/McGuire)*

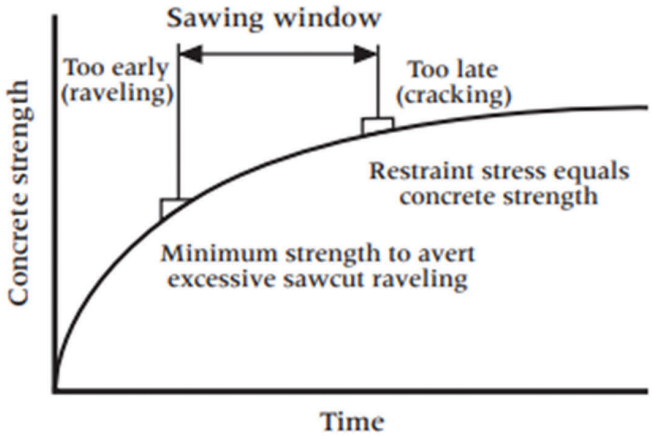


Fig. 11: The sawing window for some Type IL cement concrete slabs is very sensitive to the environment, making it difficult to avoid raveling or cracking[25]

Fig. 12: Tendons in a concrete slab constructed with Type IL concrete were stressed based on a maturity calibration for Type I cement concrete. The strength of the Type IL cement concrete was overestimated, resulting in slab blowouts

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Selected for reader interest by the editors.

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ACI - KC Board of Directors

The Annual General Meeting of the American Concrete Institute - Kuwait Chapter was conducted on 19th June, 2023, and the new Board of Directors comprising the following elected members was confirmed for the 2023-2024 term :

President	:	Mr. Ghassan Al Ghawas
Vice President	:	Dr. Saud Al Otaibi
Past President 1	:	Mr. Azizz Mamuuji
Past President 2	:	Dr. Moetaz El-Hawary
Past President 3	:	Dr. Khaldoun Rahal
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Director	:	Dr. Hasan Kamal
Director	:	Dr. Jefaarali Parol
Director	:	Mr. Moath Al Manayes
Director	:	Ms. Dana Drobiova

About the Chapter

Chapter Committees

The Chapter's affairs and activities are executed through various Committees :

- Technical Committee
- Membership Committee
- Publication Committee
- Social Committee
- Nomination Committee
- ACI-KC Students ' Committee

Technical Committee

Chairperson : Dr. Moetaz El-Hawary
Roles and Responsibilities :

- Identifying technical topics of interest to Chapter Members and arranging seminars, short courses and workshops on various topics.
- Reviewing and submitting to Chapter Members, ACI International committee reports on subjects of relevance to Kuwait.
- Reviewing proposed revisions of ACI Standards and submitting comments to Chapter's Board of Directors for submission to ACI International.
- Serving objectives of the Chapter by organizing training courses and technical workshops.
- Promoting local research and testing programs to resolve technical issues of importance for durable concrete construction in Kuwait.

Students' Committee

Chairperson : Dr. Moetaz El-Hawary
Roles and Responsibilities :

- Activities are generally in line with ACI-Kuwait Chapter objectives.
- Encouraging student participation in all activities of ACI-Kuwait Chapter.
- Student participation guided and organized by an elected Board of Directors, and sub-committees appointed from within their membership.
- Activities include technical and social events, and further information can be found on www.ACIQ8.com.

Membership Committee

Chairperson : Mr. Mansoor Rao
Roles and Responsibilities :

- Recruiting new individual members and organizations.
- Issuing and renewing membership identity cards.
- Publishing and updating Chapter's membership directory.
- Facilitating interaction amongst members and communicating their concerns to the Board of Directors and other Committees.

Publication Committee

Chairperson : Mr. Azizz Mamuuji
Roles and Responsibilities :

- Publishing periodic newsletters covering the Chapter's activities and providing general information of use to Chapter members.
- Printing and distributing copies of technical reports to Chapter members, as well as to interested individuals and concerned organizations.
- Preparing reports and Chapter news for publication in ACI's Concrete International magazine.

Social Committee

Chairperson : Ms. Dana Drobiova
Roles and Responsibilities :

- Organizing major annual Chapter events and programs for members.
- Organizing field trips to major construction projects and industries.
- Arranging participation of the Chapter in selected national events.

Nomination Committee

Chairperson : Mr. Azizz Mamuuji
Roles and Responsibilities :

- Nominating individuals who have the interest, leadership qualities and willingness to serve the Chapter, for selection to the Board of Directors.
- Submits names, prior to the Chapter's Annual General Assembly, for election by members.

Kuwait Chapter

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