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MYCONCRETE

The Bulletin of the American Concrete Institute – Malaysia Chapter (e-Bulletin)

MyConcrete

MyConcrete:
The Bulletin of the American Concrete Institute – Malaysia Chapter

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NOTE FROM MEDIA HEAD

HAPPY NEW YEAR concrete enthusiasts! We are proud to present the latest issue of the My Concrete bulletin. On behalf of the American Concrete Institute – Malaysia Chapter, we would like to thank our fellow members for their support. On top of that, as the Head of Media group, I would also like to personally highlight my appreciation to the editorial team for their efforts in providing us this monthly bulletin with informative articles and event updates.

We would like to show our gratitude to this month's article provider, Mr. Smith Yong, who touches on the topic of "Pile Head Treatment". In this article, 'non-shrink cementitious' grout is introduced and compares the differences with Epoxy Resin Grout. The other article that we shared this month is on cracks. With the permission of ACI international, we were allowed to showcase one of the articles in their bulletin on "Where Did These Cracks Come From" by Erika E. Holt.

Once again, we would like to remind members that we have started to offer a platform for our ACI student members to seek for internship, while industry members could post up for internship hiring. With this effort by ACI Malaysia, we hope to narrow the gap between students and the industry by allowing them to be exposed to "practical concrete" rather than just "theoretical concrete" from their academy.

Apart from showing our gratitude to the contribution of the technical report, we must also thank our fellow sponsors for this month's successful sharing. Our Premium Sponsor for the month is KRETEFLOR SDN.BHD who call themselves "the liquid flooring guy". Furthermore, our Loyal Sponsor this month is PLYTEC HOLDING SDN. BHD. They provide services including an academy that educates on BIM, fencing and also formwork. Without such sponsorship, we would not have been able to launch and share another successful bulletin.

To all members, we are continuously seeking for your contribution and sharing. Do contact our admin should there be any enquiries.

Once again, we like to sincerely thank all our contributors and also the media team, together with the editorial team for another month of successful sharing.

Lunar New Year is around the corner! We hope that all the members celebrating this festival enjoy this holiday and have another great year ahead. However, do follow S.O.P while celebrating the festival!

Oscar Teng
Head of Media Committee

INTRODUCTION TO ACI MALAYSIA CHAPTER

American Concrete Institute - Malaysia Chapter (ACI-Malaysia) is a non-profit technical and educational society representing ACI Global in Malaysia, which is one of the world's leading authorities on concrete technology. Our members are not confined to just engineers; in fact, our invitation is extended to educators, architects, consultants, corporate, contractors, suppliers, and leading experts in concrete related field. The purpose of this Chapter is to further the chartered objectives for which the ACI was organized; to further education and technical practice, scientific investigation, and research by organizing the efforts of its members for a non-profit, public service in gathering, correlating, and disseminating information for the improvement of the design, construction, manufacture, use and maintenance of concrete products and structures. This Chapter is accordingly organized and shall be operated exclusively for educational and scientific purposes.

Objectives of ACI-Malaysia are:

- ACI is a non-profitable technical and educational society formed with the primary intention of providing more in-depth knowledge and information pertaining to the best possible usage of concrete.

- To be a leader and to be recognized as one of Malaysia's top societies specializing in the field of concrete technology by maintaining a high standard of professional and technical ability supported by committee members comprising of educators, professionals and experts.

- Willingness of each individual member/organization to continually share, train and impart his or her experience and knowledge acquired to the benefit of the public at large.

PAST PRESIDENTS

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2012 - 2014: Dr. Zack Lim

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2016 - 2018: Ms. Serina Ho

2018 - 2020: Dr. Sudharshan N. Raman

2020 - present: Mr. Martin David

MANAGEMENT FOR 2020-2022

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NOTICE

Membership Subscription 2021

Gentle reminder that 2021 subscription is due.

Kindly note that payment can be made as follows:
Bank: Hong Leong Bank Berhad
Account Number: 291 0002 0936
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Once payment has been made, it is important to send
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Digital Membership Certificate 2021

Members who have paid their subscription will receive their digital membership certificate.
See sample below.

Internship Programme For ACI Student Members

(Subject to Terms & Conditions Apply by Companies)

Company Name	Company Address	Person To Contact	Business Involved
PLYTEC FORMWORK SYSTEM INDUSTRIES SDN BHD	No. 19, Jalan Meranti Permai 3, Meranti Permai Industrial Park, Batu 15, Jalan Puchong, 47100 Puchong, Selangor.	012 - 691 2883 (Mr.Louis Tay)	BIM Engineering Specialist, CME Project Delivery, IBS & Prefabrication Construction.
CRT SPECIALIST (M) SDN BHD	E5-5-25, IOI Boulevard, Jalan Kenari 5, Bandar Puchong Jaya, 47170 Puchong, Selangor.	012 - 313 5991 (Mr.James Lim)	Waterproofing Work, Concrete Repair & Strengthening, Injection & Grouting.
REAL POINT SDN BHD	No. 2, Jalan Intan, Phase NU3A1, Nilai Utama Enterprise Park, 71800 Nilai, Negeri Sembilan.	016 - 227 6226 (Mr.Chris Yong)	Concrete Admixture Production.
JKS REPAIRS SDN BHD	Star Avenue Commercial Center, B-18-02, Jalan Zuhal U5/178, Seksyen U5, 40150 Shah Alam.	017 - 234 7070 (Mr.Kathiravan)	Structural Repair Works, Structural Strengthening, Waterproofing System, Injection & Sealing, Concrete Demolition Works, Protective Coating For Concrete And Steel.
ZACKLIM FLAT FLOOR SPECIALIST SDN BHD	70, Jalan PJS 5/30, Petaling Jaya Commercial City (PJCC), 46150 Petaling Jaya, Selangor.	603 - 7782 2996 (Mr.Zack Lim)	Concrete Flatfloors.
UFT STRUCTURE RE-ENGINEERING SDN BHD	No 46, Jalan Impian Emas 7, Taman Impian Emas, 81300 Skudai Johor.	012 - 780 1500 (Mr.Lee)	Structural Repair, Construction Chemical, Carbon Fibre Strengthening, Protective Coating, Industrial Flooring, Soil Settlement Solution, Civil & Structure Consultancy Services, Civil Testing & Site Investigation.
SINCT-LAB SDN BHD	No 46, Jalan Impian Emas 7, Taman Impian Emas, 81300 Skudai Johor.	012 - 780 1500 (Mr.Lee)	Structural Repairing, CFRP Strengthening, Site Investigation, Civil Testing, Soil Settlement Solution, Civil And Structural Design And Submission.
STRUCTURAL REPAIRS (M) SDN BHD	No. 1&3, Jalan 3/118 C, Desa Tun Razak, 56000 Wilayah Persekutuan, Kuala Lumpur	012 - 383 6516 (Mr.Robert Yong)	Carbon Fiber Reinforced Polymer System, Sealing Cracks With Resin Injection, Re-Structure Repairs and Upgrade, Diamond Wire & Diamond Blade Sawing System, Diamond Core Drilling, Non-Explosive Demolition Agent.

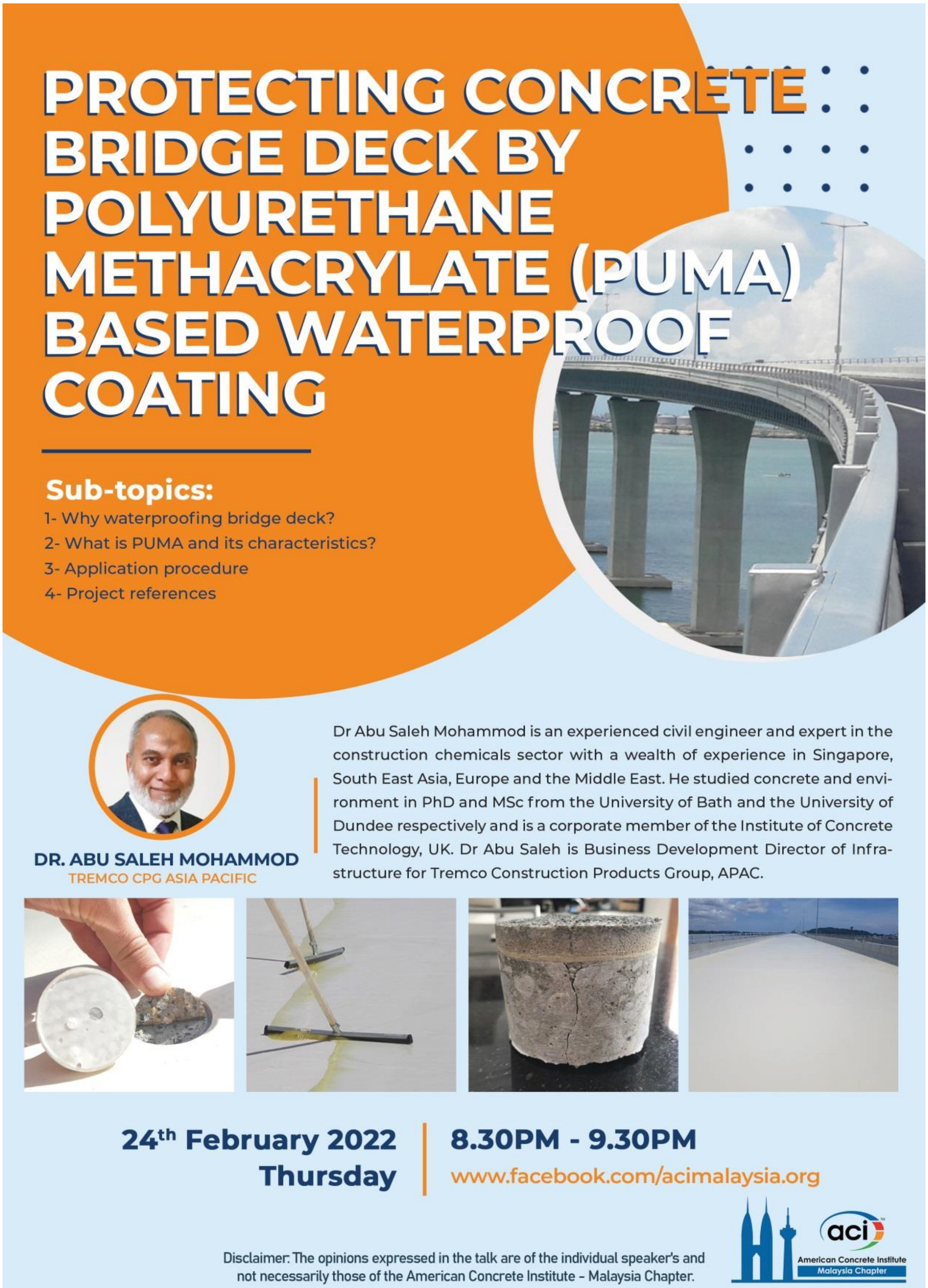
Important Notes:

i) ACI Malaysia is only a platform for our members to advertise for interns.

ii) All application to be made direct to companies and would be subject to their terms and conditions.

UP COMING EVENTS

UP COMING EVENTS



PRECEDING EVENTS

ARTICLE

Pile Head Treatment: A 2-in-1 Grouting Proposition

Writer: Smith Yong
Date: 28/12/2021

Pile foundation is one of the important structural elements in a building construction. The primary function of pile foundation is to transfer the loads from the structure above to the more compact, solid and stiffer soil which have higher bearing capacity to withstand the structural load efficiently. Typically, reinforced concrete piles are widely use in Malaysia. Pile foundations system which commonly used in Malaysia market are reinforced concrete square piles, spun piles, bored piles, micropiles and etc.

Deep basement construction is getting common in Malaysia especially at the city centres due to rapid development of the city landscape coupled with scarcity of land for new development. When the structure extends far below grade, the challenges of waterproofing work increase exponentially as the hydrostatic pressure increases.

Without efficient basement waterproofing system, issues relating to water seepages could lead to serious structural damages in the long run due to corrosion of the steel reinforcement. Concrete element in building is reinforced with steel reinforcement or wire mesh. Failure of waterproofing system may lead to ingress of water to the concrete structures. Exposure to air and water leading to corrosion of the steel reinforcement and wire mesh which eventually will result in structural damage over time. Therefore, special care and attention are essential when selecting the appropriate waterproofing solution for basement structure.

Pile head waterproofing integrity is critical in deep basement construction and careful attention must be given to ensure no leakages occur. In comparison to basement slab, pile head waterproofing work is more difficult to treat as it involves lots of detailing work especially around the congested steel reinforcement area. Water can seep through the basement structures along the reinforcement steel if it is not treated properly. Selection of reprofiling material for pile head treatment is very important as the material must be able to provide not only waterproofing properties, but also able to withstand the heavy loads from the whole building. Therefore, the pile head waterproofing treatment system shall be integrated with the basement slab to form a watertight system.

At the construction site, pile head trimming is a process is to prepare the pile head to pile cut-off level and expose the reinforcement for incorporation into the pile cap. After the trimming process, the pile head will have an undulating surface as shown in the photo below. Thus, pile head reprofiling is required prior to the pile cap casting work. It is very common to see “non-shrink” cementitious grout being used as the material to reprofile the pile head. “Non-shrink” cementitious grout is chosen because it can be easily source in the market and have high compressive strength. It is considered as an economical way to grout the pile head. However, is “non-shrink” cementitious grout the right material for the work methods employed in the above application?

Photo 1: Uneven finishing of pile head after trimming process

“Non-shrink” cementitious grout is a single component material which contains cement, graded fillers and other additives. The cement acts as the binder and upon adding water, it forms a high strength cementitious material. Is “Non-shrink” cementitious grout really does not shrink? The market term “Non-shrink” grout is commonly referred to because they contain special additives which cause volume expansion either during the plastic stage and/or the hardening stage to counter the shrinkage during curing process. For precision grouting and formwork repair applications, water lost during the curing process is well-controlled as the material is applied into a confined space and the exposure area of the grout surface is small. This application allows the grout to have a proper curing process without significant change of volume and thus minimize the formation of shrinkage cracks while maintaining a good bond with the substrate.

However, if “Non-shrink” cementitious grout is applied on expose hot weather and low humidity environment, it is difficult to control the loss of moisture during curing and that leads to rapid hardening of the grout. Improper curing may result in permanent damaging effects to the cement based “Non-shrink” grout. This gives rise to shrinkage cracks, lower compressive strength, poor adhesion and etc. Furthermore, it is very challenging to ensure proper execution and protection work on site to avoid rapid drying issue. As with all cement based material, it does not have the “waterproof” property which this essential for pile head treatment in order to prevent the ingress of ground water from the piles. If there were any defects found on the pile head surface, rectification work is mandatory prior to basement slab casting work.

What's next if "Non-shrink" cementitious grout is not suitable for pile head reprofiling work? It is perhaps time to look at epoxy grout. Epoxy grout is three components, high performance grout that derived from an epoxy based binder and a filler material. Epoxy grout use epoxy instead of cement as binder, thus making it to be waterproofed since epoxy is an impermeable material. Its zero water penetration properties provide a full waterproofing barrier to the pile head. In addition, epoxy grouts offer rapid curing, high early compressive strength and high ultimate compressive strength development. In terms compressive strength, epoxy grouts can achieve approximately 60MPa in one day and 90MPa in 7 days whereas "non-shrink" cementitious grout can only achieve approximately 30MPa of compressive strength in one day and 65MPa in 28 days.

At the job site, basement construction is always under the critical path of the construction schedule. Any delay along the critical path may affects the overall completion time of the project. With epoxy grout, the foundation contractor is able to shorten his hand over timeline to the main contractor for subsequent rebar work due to the shortened time to achieve the required compressive strength. "Non-shrink" cementitious grout takes longer time than epoxy grout to achieve its expected strength as per material data published by product manufacturer. "Non-shrink" cementitious grout takes 28 days to achieve full cure whereas epoxy grout only takes 7 days to achieve full cure condition. If the "Non-shrink" cementitious grout is not cured properly, it can lead to the formation of shrinkage cracks and thermal cracks. As a result, the durability and strength of the grout as well as the bonding to the piles will be compromised.

In contrast, epoxy grouts do not have shrinkage issue. This is one of the major benefits of epoxy grout over "Non-shrink" cementitious grout. When shrinkage and thermal cracks start to develop, coupled with high hydrostatic pressure from the ground water, water ingress from the ground will keep the basement structure wet over time. Injection grouting is the only way to solve this problem. It is impossible to hack off the existing pile head and redo the waterproofing work after the basement structure is completed.

The only reason why "Non-shrink" cementitious grout is widely used is due to the cost factor. The basement slab waterproofing system is also incomplete without considering the pile head treatment in relation to water ingress issues.

Perhaps we shall look at the overall cost instead of the upfront cost. When it comes to basement slab leaking repair work, the amount of time spend for investigation work and the remedial cost by the specialist contractor could be quite significant.

Pile head treatment is the final and most crucial application step for a successful watertight basement structure which is often overlooked. Every single pile has to be treated properly to prevent any leakage through the top of the pile. In conclusion, the differences between epoxy grout and "non-shrink" cementitious grout are summarized as table below:

Table 1: General Comparison of epoxy resin grout and "Non-shrink" cementitious grout.

Property/Aspect	Epoxy Resin Grout	"Non-Shrink" Cementitious Grout
No. of components	3-part	1-part
Chemical Reaction	Cross-linking	Hydration (Reaction with water)
Material Pot-life	Less than 30 mins (depends on site condition)	Around 60 mins (depends on site condition)
Curing time	7 days	28 days
Shrinkage Behaviour	No	Yes
Early Compressive Strength	Around 60 MPa typically (1 day)	Around 30 MPa typically (1 day)
Ultimate Compressive Strength	Around 90 MPa typically (7 days)	Around 65 MPa typically (28 days)
Bond strength on prepared dry substrates	Excellent	Good

Photo 2: Pile head treated with epoxy grout

TECHNICAL REPORT

Reprint from: CI Magazine
September 2000, Page 57-60

Where Did These Cracks Come From?

by Erika E. Holt

Construction site. Late August. End of the day. But wait, your concrete curing cannot be delayed until tomorrow. It is time to cover the concrete now before heading home to enjoy the warm evening and the gentle breeze in the yard. While taking some plastic or extra liquid to place over today's fresh concrete, you are shocked to see small cracks already on the surface. Where could they possibly come from? It must be the fault of the concrete materials! But maybe this is not the full story.

A research project was recently completed at VTT Building Technology, of the Technical Research Centre of Finland, in cooperation with industrial concrete producers. The aim of the project was to improve the quality of concrete, especially floors, with regard to shrinkage and cracking. The project focused on identifying why concrete shrinks at both the early and late ages. These long-term (late age) changes are well documented in practice, and for that reason, we design concrete with reinforcing steel, joints, and spacers to allow for volume changes. At the same time, the concrete behavior during the first hours (early age) is negligible. Recent studies show that the concrete can be significantly affected by the curing practices and environmental conditions immediately after placing. The following sections of this article provide research evidence of early-age problems that could create those bothersome cracks.

Where to start?

An early-age shrinkage testing arrangement was developed at VTT, as shown in Fig. 1 and 2, to evaluate how concrete behaves immediately after placing.[1-3] The test was conducted on a fresh concrete slab with dimensions 270 x 270 x 100 mm (11 x 11 x 4 in.) approximately 30 min after casting and traditional long-term tests continued on the same specimen. (Similar arrangements have been developed at other facilities, and VTT work is often in cooperation with these facilities.[4-6]) Measurements on the early-age specimens included horizontal and vertical shrinkage, capillary pressure,[7] temperature, and evaporation. Vertical shrinkage, or settlement, primarily occured immediately after placement while the concrete was bleeding. At approximately 2 h, the settlement ceased and most of the further volume change during early ages was shown as horizontal shrinkage. The horizontal shrinkage was measured by LVDTs (linear variable differential transducers), which are attached to two plates embedded 25 mm (1 in.) into the concrete and suspended from above. These horizontal shrinkage measurements are the values presented in the graphical depictions of the following sections. Past research has shown that shrinkage over 1 mm/m (1000 $\mu\varepsilon$) is risky because the likelihood of cracking increases.

The majority of early-age tests have been conducted and subsequently stored at 20 C (68 F) and 40% relative humidity (RH). (A hood could be placed around the whole test arrangement to prevent evaporation and simulate autogenous shrinkage so that no moisture is allowed to transfer to the

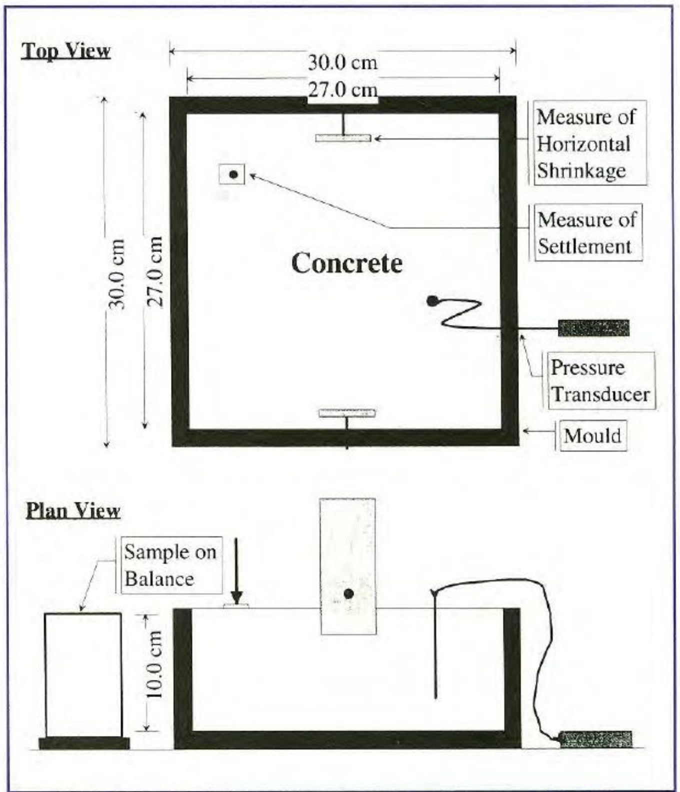


Fig. 1 Early-age test arrangement schematic (300 mm = 12 in.).

exterior surrounding environment.) In some cases, wind was used to facilitate drying and induce excess evaporation from the specimens. This article conveys research results regarding the environmental conditions and curing precautions.

This project specifically looked at the materials that were contributing to the early-age shrinkage, such as cement type and amount, environmental conditions, and admixture type and dosage.[8] Results presented here were obtained for a typical concrete floor made with 300 kg/m^3 (506 lb/yd^3 or 5½ sacks) of rapid-setting cement (Type III). Finnish natural granite aggregate was used, with a maximum size of 10 mm (0.4 in.) and a gradation with approximately 6% passing the 0.125 mm (No. 120) sieve. The water-cementitious materials ratio (*w/cm*) was 0.63 and 3% air entrainment was assumed. Tested properties included a slump of 60 to 100 mm (2 to 4 in.), final setting time of approximately 5 h, and compressive strength of 35 MPa (5075 psi).

Fig. 2 — Early-age shrinkage test in progress.

Are we talking "now" or "later"?

In the concrete world, the specifications for shrinkage begin after 1 day. But the following examples show that unhardened concrete during the first 12 h can also play a significant role in the long-term performance. If early-age shrinkage measurements are supplemented with standard long-term monitoring, the early-age can be much greater than long-term measurements. The concrete precautions provided in the first 12 h can be more important than the next 5 years of crack monitoring care! This is shown in Fig. 3 where the early-age and long-term measurements are compiled for cases of first day wind or no-wind curing environments.

The solid vertical line represents the switch in age from early to long-term. The lower curve for wet first day curing represents ideal curing conditions where there will only be autogenous shrinkage in the concrete. If the concrete is allowed to dry with no wind (middle curve), the shrinkage magnitude is equal for the first 24 h compared to the next 3 months. When drying with wind is included over the concrete surface during the first day (upper curve), the early-age shrinkage is seven times greater than the long-term shrinkage. It is obvious that the first day measurements need to be considered when evaluating shrinkage of concrete, especially in severe environmental conditions.

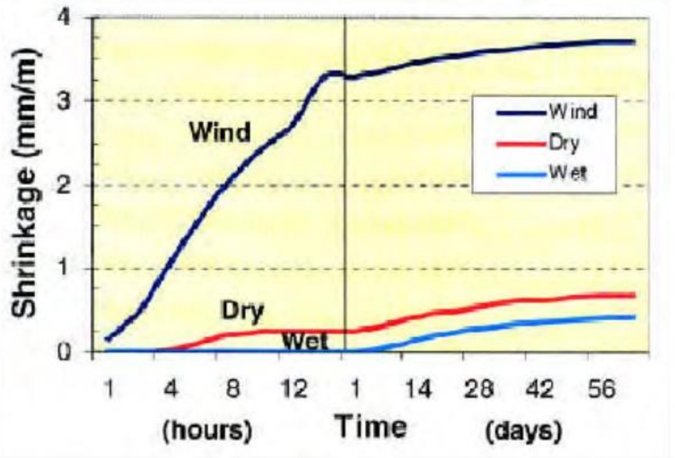


Fig. 3 — Early-age together with long-term shrinkage measurements (1 mm/m = 1000 □, wind at 2.5 m/s [5.6 mph]).

A slight breeze?

Beware of the slight afternoon breeze, as the changing wind can quickly take excess water off the top of your concrete surface. The wind can create circling air patterns that evaporate any free water. After the excess water is depleted, the evaporation will pull water out from within the internal concrete mass. This loss of water is directly responsible for increased shrinkage that will ultimately cause cracking. Figure 4 shows the influence of increasing the wind speed over fresh concrete. As the wind speed is increased, more water evaporation from the concrete occurs and greater shrinkage results. At approximately 6 h, the concrete is set enough to resist the shrinkage forces, though the evaporation can still be problematic.

Fluid blankets?

Bleed water that can rise to the concrete surface after finishing works as a barrier. As mentioned earlier, if this water is removed by the surrounding environmental conditions, there is a greater risk of cracking. The bleed water is self-curing to prevent the shrinkage, and excess water curing can also combat the drying forces. Figure 5 demonstrates how much water needs to be added to a concrete surface to prevent shrinkage.[3] The water was sprayed on the fresh concrete surface at the age of 1 h. In this case, the wind speed was approximately 4 m/s (8.9 mph) and the test specimens were mortar. The water added to the concrete surface behaves like an extra blanket to protect the concrete from losing its internal water. The more water that was added, the less shrinkage occurred.

Care must be used when adding water to a concrete surface because the water changes the surface properties of the concrete. The excess water alters the reactions with cement in the upper millimeters of the concrete. For this reason, chemical products are also available on the market that act as curing blankets. In these tests, a curing agent was sprayed onto the concrete surface immediately after placing. These chemicals act as a barrier to evaporation of water from within the concrete mass. The amount applied was altered to determine how much was needed in various environmental conditions. For normal drying conditions (40% RH, no wind) the amount of curing agent added varied, as shown in Fig. 6. In this case, approximately 100 g/m^2 (0.32 oz/ft^2) of nondiluted curing agent was sufficient to prevent shrinkage.

When wind was added to the concrete's environment (Fig. 7), the amount of curing agent required to prevent shrinkage was drastically increased to over 300 g/m^2 (0.96 oz/ft^2). Again, at 6 to 8 h the concrete was able to withstand the drying forces after setting. But shrinkage can occur early in the day on a construction site, and curing practices need to be implemented immediately after concrete placement. If you wait until the end of the day before taking protective measures, your concrete may already be suffering from early-age shrinkage cracking. As seen from these examples, it is critical to be aware of the surrounding environmental conditions during the first hours after concrete placing.

Taking care of concrete during the first hours is extremely important. You should be aware of curing methods and environmental conditions to ensure your concrete is sufficiently protected to prevent shrinkage. More evaporation occurring in the early stages results in more shrinkage, and thus, cracking, as shown in Fig. 8.

The trend in this figure is very general and encompasses only normal strength concrete with a variety of mixture proportions, but it still holds true that evaporation drives shrinkage. The shrinkage and early-age cracks will only provide additional paths for more harm, either as chemicals and water infiltrate, or for later-age cracks to lengthen along the early paths.

Methods taken during the early stages to ensure reduced shrinkage will definitely payoff in the long term. And waiting until the end of the day on the construction site to take curing precautions may not be enough to prevent those quick-appearing early-age cracks.

Acknowledgments
This work has been partially funded by a Fulbright Grant from the U.S. government, as well as VTT, TEKES, and members of the Finnish cement and concrete industry.

References

1. Holt, E., and Leivo, M., "Autogenous Shrinkage at Very Early Ages," *Autogenous Shrinkage of Concrete, Proceedings of the International Workshop*, Hiroshima, Japan, E. Tazawa, ed., E & FN Spon, 1998, pp. 135-142.
2. Leivo, M., and Holt, E., "Autogenous Volume Changes at Early Ages," *Self-Desiccation and its Importance in Concrete*, B. Persson and G. Fagerlund, ed., Lund University, Report TVBM-3075, Lund, 1997, pp. 88-98.
3. Kronlöf, A.; Leivo, M.; and Sipari, P., "Experimental Study on the Basic Phenomena of Shrinkage and Cracking of Fresh Mortar," *Cement and Concrete Research*, V. 25, No. 8, 1995, pp. 1747-1754.
4. Hammer, T. A., "Test Methods For Linear Measurements

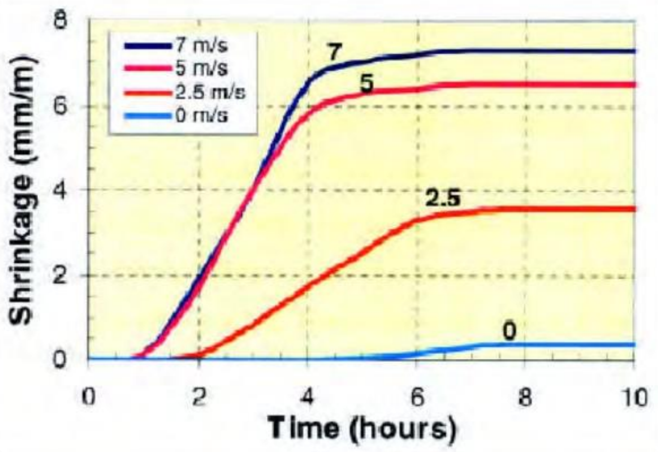


Fig. 4 — Increasing wind speed over fresh concrete (1 mm/m = 1000 □, 2.5 m/s = 5.6 mph).

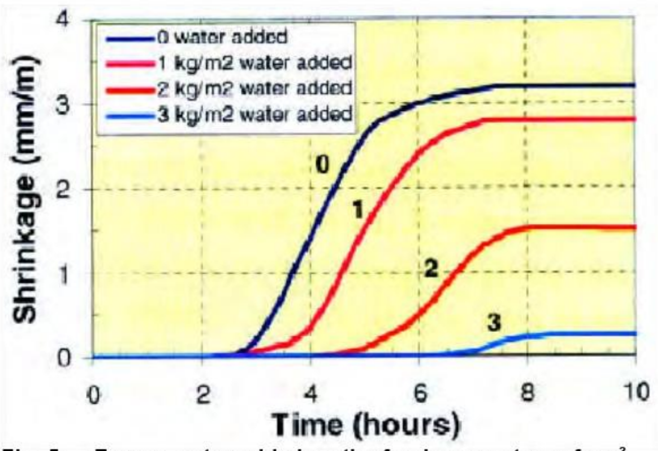


Fig. 5 — Excess water added on the fresh concrete surface[3] (1 mm/m = 1000 □, 1 kg/m^2 = 3.2 oz/ft^2).

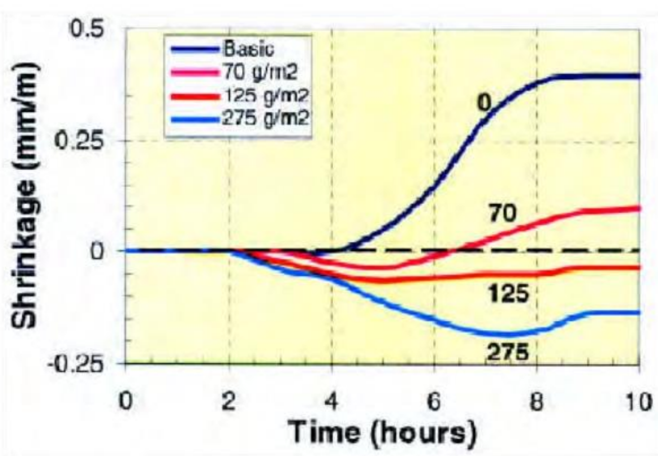


Fig. 6 — Chemical curing agent applied to the fresh concrete surface, no wind (1 mm/m = 1000 □, 100 g/m^2 = 0.32 oz/ft^2).

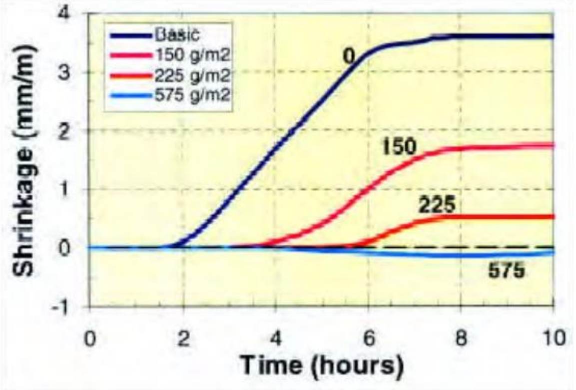


Fig. 7 — Chemical curing agent applied to the fresh concrete surface, wind at 2.5 m/s (5.6 mph) (1 mm/m = 1000 □□; 100 g/m^2 = 0.32 oz/ft^2).

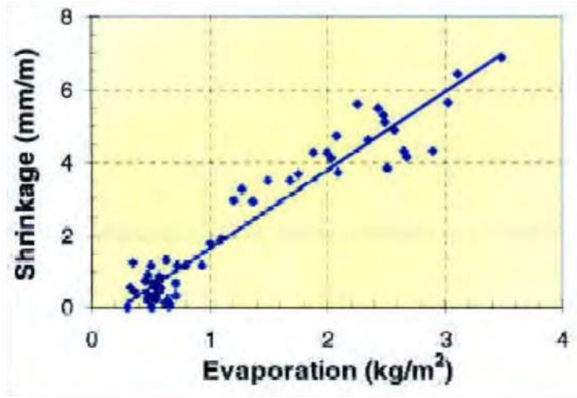


Fig. 8 — Early-age shrinkage dependence on evaporation (1 mm/m = 1000 □□; 1 kg/m^2 = 3.2 oz/ft^2).

of Autogenous Shrinkage Before Setting," *Autogenous Shrinkage of Concrete, Proceedings of the International Workshop*, Hiroshima, Japan, E. Tazawa, ed., E & FN Spon, 1998, pp. 143-154.

5. Tazawa, E., and Miyazawa, S., "Influences of Cement and Admixtures on Autogenous Shrinkage of Cement Paste," *Cement and Concrete Research*, V. 25, No. 2, 1995, pp. 281-287.

6. Radocea, A., "A Model of Plastic Shrinkage," *Magazine of Concrete Research*, V. 46, No. 167, June 1994, pp. 125-132.

7. Radocea, A., *A Study on the Mechanisms of Plastic Shrinkage of Cement-Based Materials*, PhD thesis, CTH Göteborg, Sweden, 1992, 125 pp. + 3 app.

8. Holt, E., and Leivo, M., "Reducing Early-Age Concrete Shrinkage With the Use of Shrinkage Reducing Admixtures," *Proceedings*, Nordic Concrete Research, Reykjavík, Iceland, 1999, pp. 234-236.

Received and reviewed under Institute publication policies.

Erika E. Holt is an ACI member and research scientist in the Building Technology division of VTT, The Technical Research Centre of Finland. She is a Seattle resident and completed her MS in civil engineering at the University of Washington in 1997, after which she was awarded a Fulbright grant to continue work in Helsinki. Her current research on early-age shrinkage is being applied towards her PhD.

CASE STUDY

Reprint from: CI Magazine
July 2021, Vol. 4, No 7, Page 42-43

Enerpac Strand Jack Technology Used in Construction of Cline Avenue Bridge

The bridge span was completed in just 16 days

The recently completed Cline Avenue Bridge is an elevated expressway in East Chicago, IN, USA, that connects the SR 912 to Interstate 90 (I-90). The bridge is 6236 ft (1901 m) long with a 316 ft (96 m) main span over the Indiana Harbor and Ship Canal, providing 100 ft (30 m) of vertical and 200 ft (61 m) of horizontal navigational clearance. The canal needed to remain open to barge traffic during the construction of the bridge, so heavy-lift specialist Engineered Rigging used Enerpac strand jack technology instead of a traditional crane approach to complete the span.

Project Background

The Cline Avenue Bridge project was privately funded. Low-maintenance concrete and a blend of traditional and new construction techniques were used to provide an expected lifespan of over 100 years. The bridge comprises 29 cast-in-place concrete piers supporting 685 post-tensioned concrete single-cell box girder segments, with typical spans that vary between 170 to 290 ft (52 to 88 m). The piers range in height from 24 to 86 ft (7 to 26 m).

The bridge was constructed using the balanced cantilever method, in which precast segments are erected on each side of a pier in a balanced sequence to minimize bending in piers and foundations. To complete each span between adjacent piers, a nominal 4 ft (1.2 m) cast-in-place closure segment was placed at midspan, followed by stressing of continuity tendons across the closure segment. In total, 28 closure segment placements were required to complete the bridge. Most of the precast segments were lifted and set using two large-capacity, ground-based cranes. But because much of the span over the ship canal was beyond the reach of the ground-based cranes, a different approach was required.

Construction of the Canal Span

The span over the 130 ft (40 m) wide Indiana Harbor and Ship Canal comprises 19 precast segments stretching 380 ft (116 m) column to column. While a crane on a barge could have been used to erect precast segments beyond the reach of the ground-based cranes, this approach would have meant closing the canal to commercial barge traffic for weeks. Given the volume of maritime traffic that needs to use the canal, this was not a viable option. A creative yet pragmatic approach was needed.

“Cranes are great for lifting heavy objects, but their sheer size and cost often makes them impractical for some applications. Both factors came into play for the Cline Avenue Bridge project,” says Christopher Cox, President of Engineered Rigging. “Engineered Rigging was consulted to develop a practical alternative, and our expert engineering team was up for the challenge,” he continues.

Cox and his team had to account for factors such as the weight and size of each segment and the need to keep disruptions to the busy canal to a minimum. Each bridge segment measured 10 ft (3 m) high, 10 ft deep, and 25 to 30 ft (7.6 to 9.1 m) wide, and weighed 75 tons (68 tonnes).

The Cline Avenue Bridge under construction. The bridge crosses the Indiana Harbor and Ship Canal

Engineered Rigging chose Enerpac strand jack technology to complete the span over the canal

Engineered Rigging's solution was to use Enerpac strand jacks to lift the segments into position.

Strand jack technology

While strand jacks are not the quickest lifting method, they provide massive lifting power in a small package. Moreover, they are secure, and their operation makes them essentially fail-safe.

A strand jack can be considered a linear winch. A bundle of steel strands are guided through a hollow hydraulic ram. Hydraulically actuated grip mechanisms (anchors) alternately grip each strand in the bundle above and below the ram. An electric-powered hydraulic pump is used to stroke the piston out and in while the grips are engaged in the anchors, and thus a lifting or lowering movement is achieved. For lifting, the top anchor engages to pull the strand bundle during the upstroke of the ram piston. When the piston reaches its maximum upstroke (out), the bottom anchor engages to hold the strand bundle and the top anchor releases. The piston then returns to its bottom (in) position. Over time, Enerpac has refined the strand jack technique, making it easier to deploy and manage with automated locking and unlocking operation, as well as enabling precision and synchronous lifting and lowering by a single operator.

Engineered Rigging developed a customized cantilever segmental bridge lift platform using back span tie downs to counter the cantilever overhanging the bridge. Two beams, each with two 70 ton (63.5 tonne) strand jacks, extended from the platform.

As each new segment was added, the platform was moved forward using a combination of Enerpac launching cylinders and a low-height skidding system.

The span construction involved placing a precast segment on a barge, moving the barge under the cantilever lift system, and attaching four strand bundles to the segment. Over the course of the next 2-1/2 hours, the strand jacks lifted the segment 130 ft into position. During the final lifting stages, the strand jacks were also used to tilt and manipulate the segment as it was attached to the previously placed segment. Initially, one segment was lifted and installed each day, but when canal traffic was light, up to three segments per day were added.

Engineered Rigging completed the bridge span in just 16 days. Mike Beres, Project Lead for Engineered Rigging, points to the importance of synchronized lifting when using multiple strand jacks. "Enerpac strand jacks were integral to the safe and on-time completion of the project. They pack tremendous lifting capacity into a small footprint," he says. "Moreover, the system software can control up to 60 jack/pump combinations, so the potential for synchronous lifting is quite scalable. The flexibility of the strand jack system has allowed Engineered Rigging to use this equipment on many other projects across multiple industries," he explains.

Project Completion

The new 1.7 mile (2.7 km) long Cline Avenue Bridge opened on December 23, 2020. The new bridge cost private operator United Bridge Partners more than $100 million to build as a link to the casinos and steel mills along Lake Michigan. The two-lane bridge is expected to carry 10,000 vehicles daily.

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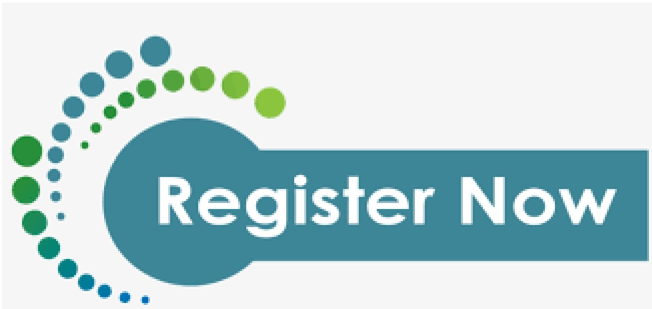

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