The strength, durability,

versatility and beautiful finish of our Aegis Type IS Cement make it the product of choice among engineers and architects.

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introduction

Stronger and Longer Lasting - Building Bridges

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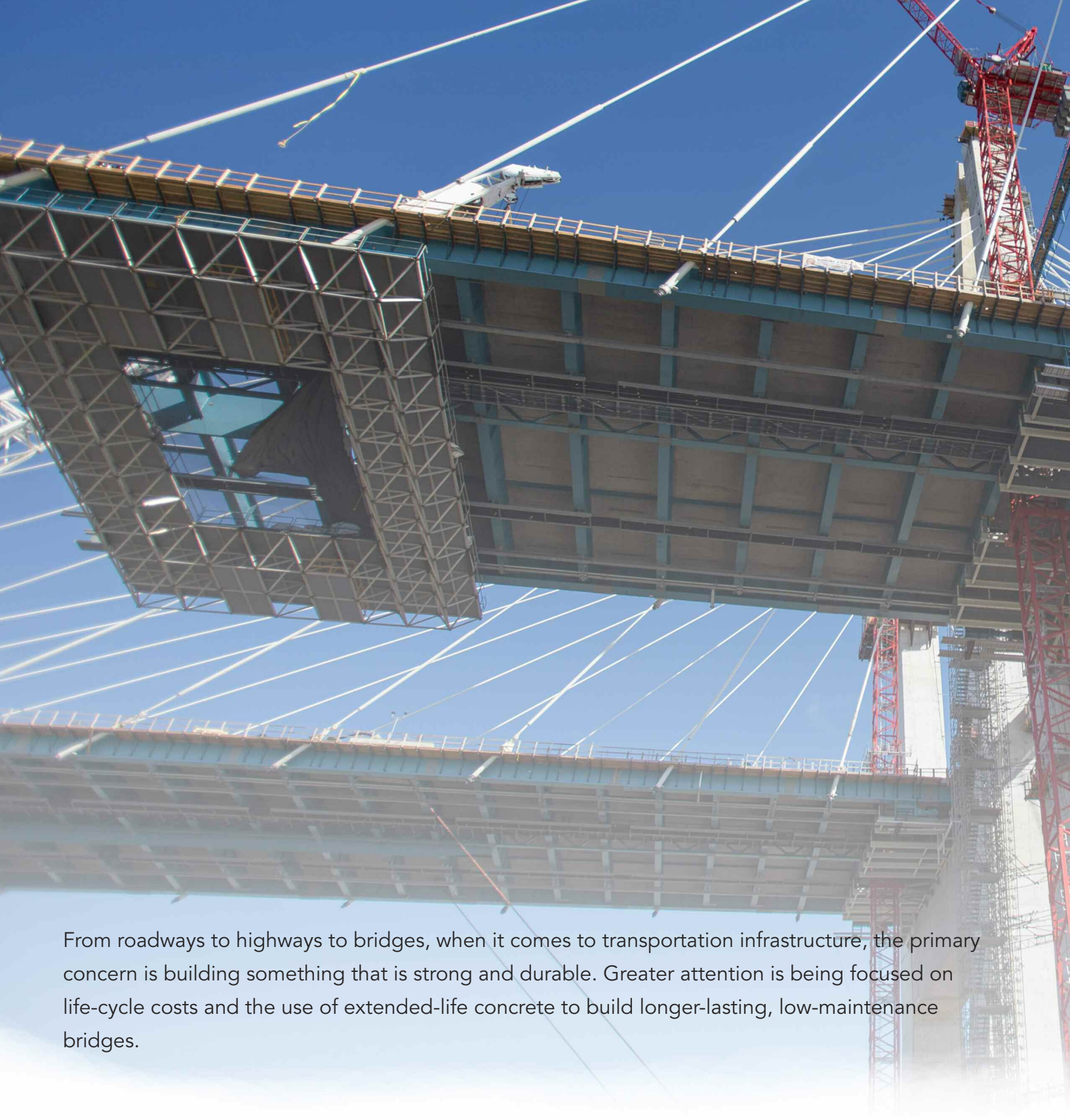

From roadways to highways to bridges, when it comes to transportation infrastructure, the primary concern is building something that is strong and durable. Greater attention is being focused on life-cycle costs and the use of extended-life concrete to build longer-lasting, low-maintenance bridges.

Case Study: The Tappan Zee Bridge is a twin cable-stayed bridge built to replace the original Tappan Zee Bridge over New York's Hudson River. The bridge was designed for a 100 year service life and utilizes slag cement in almost every portion of the bridge, from the top of the cable stay columns to the mass concrete foundations.

Spanning over 3 miles long and nearly 200 feet wide, the bridge used 300 thousand cubic yards of concrete during its over 4 year construction. **Slag cement was used for low heat in mass concrete to control shrinkage, creep and prevent thermal cracking.**

The vision was to build a state-of-the-art bridge that would last at least a century, alleviate regular traffic jams and improve driver safety conditions on a bridge plagued with frequent accidents, narrow lanes and a lack of shoulders. The project would not have been able to meet its 100-year service life requirements without slag cement and its contribution to increased strength and lower heat.

what is slag cement?

Slag cement, or ground granulated blast-furnace slag (GGBFS), has been used in concrete projects in the United States for over a century. Earlier usage of slag cement in Europe and elsewhere demonstrates that long-term performance is enhanced in many ways. Based on these early experiences, modern designers have found that these improved durability characteristics help further reduce life-cycle costs and lower maintenance costs.

Using slag cement to replace a portion of portland cement in a concrete mixture is a useful method to make concrete better and more consistent. Among the measurable improvements are:

- Better concrete workability
- Easier finishability
- Higher compressive and flexural strengths
- Lower permeability
- Improved resistance to aggressive chemicals
- More consistent plastic and hardened properties
- Lighter color

When iron is manufactured using a blast furnace, the furnace is continuously charged from the top with oxides, fluxing material, and fuel. Two products—slag and iron—collect in the bottom of the hearth. Molten slag floats on top of the molten iron; both are tapped separately.

The molten iron is sent to the steel producing facility, while the molten slag is diverted to a granulator. This process, known as granulation, is the rapid quenching with water of the molten slag into a raw material called granules. Rapid cooling prohibits the formation of crystals and forms glassy, non-metallic, silicates and aluminosilicates of calcium.

These granules are dried and then ground to a suitable fineness, the result of which is slag cement.

AEGIS

how does slag cement improve strength?

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How Does Slag Cement Improve Strength?

Slag Cement is manufactured using less production energy than Portland cement. Use of this material may contribute to achieving points or credits in LEED® or other green building assessment systems in your country. Slag Cement is a building material which is used in a wide variety of commercial and architectural concrete construction applications. Uses include cast-in-place, precast, bridges roads, pipe, blocks, pre-stress concrete mixtures, masonry mortars, grouts, agglomerating and solidification. When properly proportioned in concrete mixtures, Slag Cement is particular suitable for providing light color, sulfate and alkali-silica reaction (ASR) resistance, low permeability and low heat for mass-concrete applications.

Why Are Improved Strengths Important?

Concrete made with slag cement provides higher compressive and flexural strengths compared with straight portland cement concrete. Improved strengths make it easier to achieve specified safety factors of the concrete mixture and can provide engineers with a tool to optimize concrete element designs. It provides enhanced material properties allowing producers to optimize concrete mix designs. Owners may realize decreased life cycle costs.

Compressive and Flexural Strength

Slag cement increases the compressive and flexural strength of conventional concrete and is a key component in producing high strength concrete. 28-day strengths generally increase as the percentage of slag increases - up to 50% slag cement as a percent of cementitious material (AEGIS Slag Cement is, in fact, a 50:50 blend). Slag cement has a significant effect on the flexural strength of concrete. Flexural strength (or modulus of rapture) is one of the main factors in concrete pavement design. This is attributed to the fact that the slag content increases the denseness of the paste and improves paste-aggregate bond.

slag cement and life cycle prediction models

What Are Life Cycle Prediction Models?

Life cycle prediction models are engineering tools developed from an understanding of concrete performance, gained from basic material research and engineering practice and used to predict the life and establish the cost of a structure, including maintenance and repair. This cost is a balance between the initial fixed cost of construction labor and materials and the variable cost of extended maintenance and repair (subject to the time value of money). Poor initial choices in material selection or construction practices can lead to long-term maintenance and repair expenses that exceed the cost of construction.

Life Cycle Cost Of Concrete Construction

Some of the properties that may increase the useful life of a concrete structure and decrease life cycle cost are:

- Low permeability
- Increased corrosion resistance
- High compressive and flexure strength
- Improved resistance to sulfate attack
- Reduced thermal stress

Slag Cement, Life Cycle Prediction And Cost

The use of slag cement to produce concrete can significantly improve the durability of concrete in several ways and consequently extends the life of concrete structures.

Chemically, slag cement improves resistance to aggressive sulfate solutions and mitigates deleterious reactions between cement alkalis and reactive silica in aggregates.

Physically, slag cement reduces the heat of hydration, thus lessening thermal cracking and improves ultimate compressive and flexural strength. During the life of the structure, these strengths normally increase well beyond the 28-day specified strength, significantly more than plain portland cement concrete.

Possibly the most important effect provided by the use of slag cement is decreased concrete permeability. Lowered permeability inhibits the ingress of chloride ions that can contribute to corrosion of reinforcing steel. Additionally, keeping water out of the concrete matrix significantly decreases susceptibility to many durability problems, such as sulfate attack and ASR.

What is Permeability?

Permeability is a measure of how easy it is for water, air and other substances such as chloride ions to enter concrete. Concrete contains pores that allow these substances to enter. Larger pores allow easier entry, while smaller pores decrease the rate at which these substances enter the concrete.

reducing permeability with slag cement

When portland cement hydrates, it forms calcium-silicate hydrate gel (CSH) and calcium hydroxide ($Ca(OH)_2$). CSH is the "glue" that provides strength and holds the concrete together. Permeability is related to the proportion of CSH to $Ca(OH)_2$ in the cement paste. The higher the proportion of CSH to $Ca(OH)_2$, the lower the permeability of the concrete. When slag cement is used as part of the cementitious material in a concrete mixture, it reacts with $Ca(OH)_2$ to form additional CSH, which in turn lowers the permeability of the concrete. Generally, the higher the percentage of slag cement in a concrete mixture, the lower the permeability of the concrete. Concrete with lower permeability can generally be achieved by substituting between 25 to 65 percent slag cement for portland cement.

Factors affecting permeability of concrete:-

1. Water-Cement Ratio
2. Improper Compaction of Concrete
3. Improper Curing
4. Age of concrete
5. Pore structure
6. Degree of compaction

what is sulfate attack

Mitigating Sulfate Attack

One of the most common ways of protecting against sulfate attack is to reduce the alumina content by limiting the C_3A in portland cement. Historically, Type II portland cement (with C_3A between 5 and 8 percent) and Type V portland cement (with C_3A less than 5 percent) have been specified for moderate and severe sulfate environments, respectively. However, slag cement has been tried and tested and found to be an extremely effective way of reducing the potential for sulfate attack, with further reaching benefits.

How does Slag Cement Mitigate Sulfate Attack?

The use of slag cement reduces the likelihood of sulfate attack in three ways:

1. Slag cement does not contain C_3A, so its addition in concrete dilutes the total amount of C_3A in the system.
2. Slag cement reduces concrete permeability, making it harder for sulfates to penetrate into concrete.
3. Slag cement reacts with excess $Ca(OH)_2$ to form additional calciumsilicate hydrate gel (the "glue" that provides strength and holds the concrete together). This decreases the total amount of $Ca(OH)_2$ in the system.

What is Sulfate Attack?

Sulfate attack is a common form of concrete deterioration. It occurs when concrete comes in contact with water containing sulfates (SO_4). Sulfates can be found in some soils (especially when arid conditions exist), in seawater, and in wastewater treatment plants.

Waterborne sulfates react with hydration products of the tri-calcium aluminate (C_3A) phase of portland cement, and with calcium hydroxide ($Ca(OH)_2$) to form an expansive crystalline product called ettringite. Expansion due to ettringite formation causes tensile stresses to develop in the concrete. When these stresses become greater than the concrete's tensile capacity, the concrete begins to crack. These cracks allow easy ingress for more sulfates into the concrete and the deterioration accelerates. Sulfates also cause chemical disintegration of some of the cement hydration products.

Principal factors that affect the rate and severity of sulfate attack are:

1. Permeability of the concrete.
2. Concentration of sulfates in the waterborne solution.
3. C_3A content.
4. $Ca(OH)_2$ content.

reducing thermal stress in mass concrete

What is Mass Concrete?

According to ACI 207, "mass concrete is any large volume of concrete with dimensions large enough to require that measures be taken to cope with the generation of heat and attendant volume change to minimize cracking." Cement hydration generates heat. Heat dissipates from concrete slowly; the thicker the section, the longer it will take the interior to cool. This can result in large temperature differentials between the concrete surface and its interior. The concrete is then subject to high thermal stresses, which can result in cracking and loss of structural integrity.

Reducing Thermal Stress

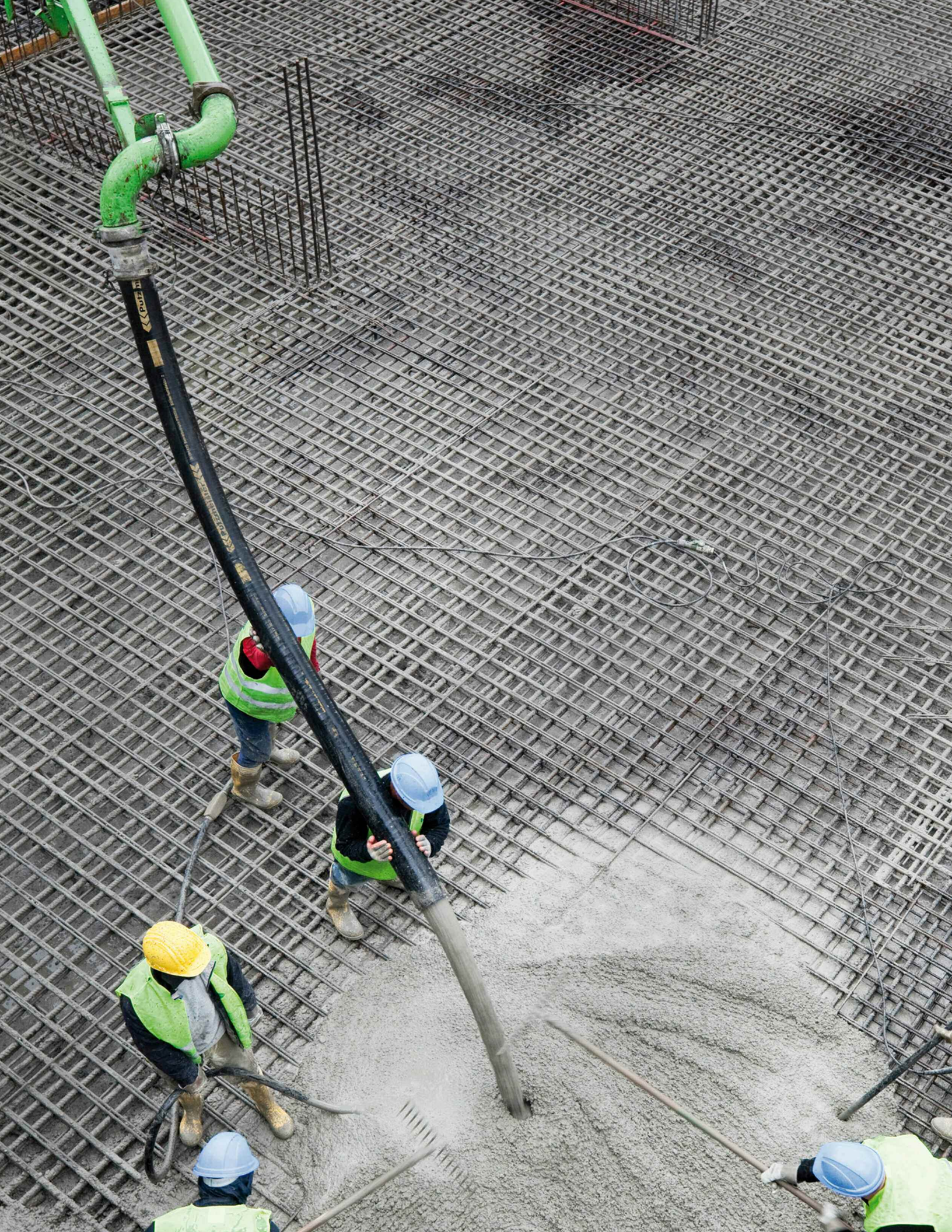
There are three generally accepted strategies for reducing thermal stress in concrete:

- Reduce the total cementitious content.
- Reduce the portland cement content.
- Slow down the hydration process through the use of various admixtures or cooling the concrete.

How Does Slag Cement Help?

When slag cement is incorporated in a concrete mixture, less heat is generated and thermal stress is reduced:

- Due to increased strength with slag cement, the total cementitious content can be reduced
- Portland cement content is reduced by the percentage of slag cement used
- Hydration characteristics of slag cement are such that the early rate of heat generation and peak temperature of the concrete are reduced.



specification

ASTM INTERNATIONAL

ASTM International, formerly known as American Society for Testing and Materials, is an international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services.

Our cements are designed to give you more:

- Industrial control standards that ensure consistent high quality.
- Product performance and handling properties that exceed your expectations.

OUR COMMITMENT TO YOU:

- We apply a hands-on approach with architects, developers and engineers in an attempt to work cohesively and achieve optimum results by promoting the use of cement and other materials that enhance the final product.
- We seek out new construction entrepreneurs and DIY homeowners and advocate more user-friendly, efficient products and support services.
- We work at building long-term business relationships.
- We listen to the market's needs and strive to innovate products and services that distinguish us from our competitors.

Customers have the our guarantee that all cement sold will carry the ASTM standard and all cement delivered will proudly display our Mill Test reports. This will give the assurance that our cement has been formulated to achieve the strength specified on the bag.

aegis simple steps for success

Whether building a dream home or furthering a business, success comes from paying attention to some basic principles:

- Use reliable quality materials.
- Avoid wastage by using good materials and good systems.
- Plan your work carefully and lay solid foundations.

Be absolutely consistent with mixing your concrete, mortar or plaster: Short cuts are the pathway to long term problems.

Think SAFETY before you start any job.

Out of sight, out of mind! So often foundations are subjected to cost-cutting but yet are so important for building a sound, long-lasting structure:

- It pays to employ a specialist to check the soil conditions of the site.
- Prepare an area for mixing. If there is no concrete surface, use a sheet of metal to avoid the contamination and water variation problems with mixing on the ground.
- Use a good quality cement. AEGIS TYPE IS SLAG CEMENT will give a good workable mix for easier handling, placing and finishing. AEGIS CEMENT mixes also develop their strength quicker – saving time and money.

reduced impact on the environment

GGBFS is a truly GREEN product as there are no CO_2 emissions at the steel mill or grinding plant.

The use of Type IS Cement has demonstrated long-term performance enhancements allowing designers to reduce the environmental footprint of concrete while ensuring improved performance and increased durability.

6 CONCRETE BENEFITS OF WORKING WITH SLAG CEMENT

Increased Strength Gain
Reduced Permeability
ASR Mitigation
Sulfate Resistance
Thermal Stress Reduction
Improved Workability


ECO FRIENDLY

Choose the right Cement

AEGIS CEMENT NEXT GENERATION

case study

Type IS Cement and its exceptional characteristics including increased durability, ASR mitigating properties, and its ability to stabilize the cement paste to create a more robust environment for the development of air entrainment make it an ideal choice for road works.

In 2011, an 88-lane mile stretch of the I-275 highway was repaved through Wayne and Oakland Counties, in Metro Detroit, Michigan. This project did not include Type IS Cement and the road surface failed due to ASR and a poor air void system. The Michigan Department Of Transportation (MDOT) specified the use of Type IS Cement for its hardened concrete characteristics such as increased durability, and ASR mitigating properties. MDOT is also of the opinion that Type IS Cement helps aid in creating a more stable paste for the proper development of air entrainment. The contractor, who favored Type IS Cement for its rheological properties, appreciated its added creaminess and its ability to hold a nice edge. Therefore, Type IS Cement was instrumental in delivering the best road surface and finished product for MDOT and motorists.

The I-96 Reconstruction (2014)

- Type IS Cement was used in concrete mixtures for the roads and bridges.
- The road portion of the project used 62,000 tons of Type IS Cement in a 70:30 ratio of OPC:Slag.
- Using Type IS Cement resulted in a lighter appearance for enhanced nighttime visibility.
- The consistency and performance reliability of the mixture also contributed to rapid completion of the project.
- A minimum of 30% slag cement ratio was needed to provide mitigation of potential akali-silica reaction (ASR) as required by the Michigan Department of Transportation (DOT) concrete specifications.
- Had higher ratios been utilized, the finished product would have been even better.
- AEGIS Type IS Cement offers a blend of 50:50 [OPC: Slag] for maximum performance and workability.

case study

JFK-104.002 – Runway 4L-22R Runway Safety Compliance and Reconstruction Project, is located in New York City and is owned by the Port Authority of New York and New Jersey. The 267 million dollar portland cement concrete pavement project consisted of rehabilitating the existing asphalt runway with a concrete overlay. The existing runway was milled approximately six inches deep; then a two-inch levelling course of asphalt was used prior to the placement of the 18-inch concrete overlay. A full-depth 18" concrete pavement was used to widen the runway by 50' and add an extension of 700' for a final 12,700' by 200' new runway with 40' wide shoulders. This rehabilitation and widening project enhances the efficiency of the airport and 4L-22R will handle about 25 percent of the annual operations and in compliance with requirements for Group VI aircraft.

The John F. Kennedy International Airport

Slag Cement Type IS

Concrete mix specifications for this project required a minimum flexural strength of 700 psi at 28 days with a maximum cementitious content of 550 lb/cy. The specifications also required the mix to have a low chloride permeability as measured by the Rapid Chloride Permeability Test. The Port Authority Materials division recommended using slag cement as part of the mix design since slag cement increases flexural strengths, reduces the concrete permeability, and makes the concrete more resistant to alkali-silica reaction (ASR). In order to achieve the concrete pavement slipform construction requirements and meet the contract specifications, a Type IS (40) cement was used in the concrete mix.

ASTM C595 Type IS (40) designates a portland blast-furnace slag cement that contains 40% slag, a recycled material that reduces the environmental footprint of the concrete. Laboratory mix design testing yielded in a 28-day flexural strength of 1300 psi. This concrete mixture met performance requirements for constructability, strength, durability, and smoothness – all at a reduced environmental impact, and is thus recognized as the 2015 Project of the Year Award recipient in the category of sustainability.

the philosophy behind aegis cement

Aegis Has Greek and Latin Roots

Aegis Has Greek and Latin Roots

We borrowed "aegis" from Latin, but the word ultimately derives from the Greek noun *aigis*, which means "goatskin." In ancient Greek mythology, an aegis was something that offered physical protection. In some stories, it was the thundercloud where Zeus kept the thunderbolts he used as weapons or the name he gave to the shield he used to protect his people. In others, the aegis was a magical protective cloak made from the skin of the goat that had suckled Zeus as an infant. The word first entered English in the 15th century as a noun meaning "shield" or "protection," and by the 20th century it had acquired the extended senses of "auspices" or “sponsorship."

The philosophy behind our brand is deep-rooted in strength, protection, stability and reliability. We are proud of our name and every element of our crest has been well thought-out:

(i) shield engraved with A for Aegis - significant of Zeus's shield;
(ii) two swords - denote protection and strength;
(iii) crown - respect;
(iv) laurel wreath - symbolic of victory and honor.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