Life Cycle Assessment of Concrete Buildings

Human Resources Challenges and Sustainability & Regulations
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Please visit the electronic version of Concrete InFocus at http://www.nrmca.org/news/connections/ for bonus features, including Part II of Life Cycle Assessment of Concrete Buildings, Quality Corner, Producer Profile and the final installment of Repair Shop Safety.
Human Resources Challenges

By Eileen Dickson, Vice President, Education, NRMCA
Part 1: Difficult Conversations

**Sales Rep Steve:** Hey, John, I picked up your urgent message about a problem with the delivery at ABC Concrete Contractors. You sounded really anxious. What's up?

**Sales Manager John:** I'll tell you what's up. The mixer driver called dispatch relating that the site supervisor said that the mix at the university's new warehouse floor is not setting as quickly as it should. In fact, it is so out of whack that he not only cancelled the balance of the order but also wants us to cover their labor costs to remove what we delivered and pay their fine from the general contractor for the delay. The entire job is stopped until this floor is done - the fine could be enormous. This is totally unacceptable. ABC was your key account until Andy took it over a month ago. The fact that you got called with the order rather than Andy should have meant that it was perfect; you know this client well: every order, every time, needs to be closely monitored.

**Steve:** Please, I don't need to be told that ABC is an important account - I built it. As for this pour at the university, I was there for the first load and, yes, it did look too wet but I watched how things were going. No one mentioned it. In fact, the finishers were very happy, the power trowel helicoptered across the mud easily. No one complained one iota. Second, you signed off on the order. If we screwed up, you, I and QC screwed up because I entered the mix that was specified in our software program. No flags came up that something was amiss. I agree we have to fix it but this does not fall on me alone.

**John:** Fine to say after-the-fact, Steve, but you know the importance and prestige of doing business with ABC Contractors and it is up to you to get all the details about the pour, quirks to expect and how to keep ABC happy. As a senior person, I pay you get it right all the time, every time. Capisce? Is there anything you don't understand about the duties of your job? What happened this morning does not solve the financial or legal ramifications of delivering a wrong mix. It is not my responsibility to read every line of the order: you have over 20 years of experience. We invested heavily in that new software package to assure you get it right. All I hear from you are excuses and transferring the blame.

There is no denying that difficult conversations related to expected performance happen. Conversations of this nature are part of the very fabric of business. The conflicts we are focusing on in this article are those that are always dreaded and unpleasant. One essential way to reduce conflict, increase employee satisfaction as well as their engagement in their job is for managers to know how to participate in such difficult conversations, thereby negating the stressed relationship so many employees (55% according to research group The Conference Board) feel with their boss and job.

If we assume this type of difficult conversation impacts an employee's job satisfaction and engagement in executing his/her job, then we must also ask what can be done about it. As ready mix producers face rebuilding a workforce post-recession, focusing on building a cohesive work culture, centered on technical know-how, cost effectiveness, productivity and efficiency is important. Additionally, when you simply factor in the rising cost of health care and worker's comp claims from stressed, overweight and depressed employees, those factors ultimately add more to your expenses.

Still believe your staff's technical skill competence is your leading competitive edge? An American Management Association study, *Keeping the People Who Keep You in Business*, reports that employees who are emotionally unhappy at work disengage from the job during the day. Digest this: the U.S. Department of Labor (DOL) released a 2010 study finding the average U.S. employee is disengaged at least two hours a day. The DOL then developed a formula to measure the cost of “disengaged employees.” It determined the average employee hourly salary, from CEO to the entry level worker, is $32/hour. Crunching the numbers, the actual cost of the disengaged employee calculates as:

- $32 per hour x 2 hours = $64/day
- 5 days/week x $64 = $320 per week per employee
- $320 x 4 weeks = $1,280 month
- $320 x 50 weeks = $16,000 per year
- $16,000 x 100 employees = $1,600,000 in lost revenue and productivity.

With the ready mixed concrete industry’s 2009 earnings before interest, taxes and depreciation (EBITA) released in

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NRMCA’s Operations, Safety and Environmental Committee recently formed a new Human Resource task group. The group will also work with NRMCA’s Business Administration Committee. It is actively looking for members, both those in operations performing supervisory, personnel risk abatement, and the gamut of the range of personnel tasks as well as human resource professionals. For further information about the group or to volunteer, please contact Eileen Dickson at edickson@gmail.com.

The following series launches an ongoing look at a variety of human resources/human capital challenges that a wide spectrum of managers deal with all the time.
the NRMCA 2010 Industry Data Survey coming in at a mere $3.70 per cubic yard of concrete, making up the $1,600,000 in lost productivity equates to pouring an additional 430,000 cubic yards to cover that deficit - annually. So perhaps those hard numbers will have you consider what experts have been preaching for years: the interpersonal skills your employees bring to the table are at least as important as their technical skills.

To further understand why conflict can negatively impact your business, in a 2009 study the Society of Human Resource Management (SHRM) revisited what top factors make employees satisfied at work, that is, keep them engaged. Remaining in the top 10 are: an employee’s relationship with his/her immediate supervisor, management’s recognition of employee job performance, and communication between employees and senior management. Looking at the flip side, a dissatisfied employee would therefore reflect a negative satisfier as dealing with lack of communication, recognition and conflict.

Finding the Conversation Gap

Experts from the Harvard Negotiation Project inform us that if managers only focus on how to deliver a message when holding difficult conversations, the relationship between the employer and employee will not improve. There has to be the option of a dialog back and forth, that is, the manager has to be willing to be open enough to learn from what is discussed in the conversation.

Second, managers have to program themselves to realize that all conversations actually have a common structure and watch for the structure to unfold. While you would think this should be second nature, most of us do it fairly poorly. We typically focus on the actual words being said while a conversation’s structure also includes what both parties are thinking and feeling. They get reflected in the tone of voice and body language. If parties are missing those important clues, gaps occur from misinterpretation. If we fill those gaps incorrectly, misunderstandings occur. How many times do we hear people say, “That’s not what I meant at all. You are blowing this way out of proportion.”

In a famous scientific study over 40 years ago, and validated many times since, participants interpret what is “said” by combining three factors: the actual words, the tone of the voice and the body language of the speaker. Here’s what many fail to realize: the impact of the actual words is minimal when compared to the tone and body language. What the speaker is feeling and thinking impacts their body language and tone of voice. A whopping 93% of what is said in a conversation has nothing to do with the words coming out of someone’s mouth.

The Conversation Structure

Let’s decode the conversation between sales rep Steve and sales manager John. Both took the stance that he were right and the other wrong. There was a lot going on between the two that was not spoken. Let’s look at what unsatisfied employee, Steve, thought as he listened to John:

Well, he sure delivered his message, AGAIN. How stupid does he think I am? I’ve had it. It’s obvious he wants me gone so he can hire some cheap college kid. We’ll see about that. With 23 years here and a track record, I will not go quietly. I not only got
John complaining.

out of the ball park when Lenny’s son called John signed off on it so fast the ink didn’t dry. John signed off on it so fast the ink didn’t dry. Then he did a 180 and totally reacted out of the hall park when Lenny’s son called John complaining.

I have a great relationship with the Lenny - why didn’t he come to me rather than have his son call Steve? I was thrown under the bus. This is a lose-lose scenario for ABC and us and I’m afraid I’ll end up the sacrificial lamb. I’m the good guy here and what do I get as a reward? - hammered from both ends. Admittedly, the concrete was obviously wetter than it should have been but the site supervisor and finishers were happy with how quickly they could drive that power trowel around. With the pressure I’m under to bring in business, there was no reason to stay for the second load to see if a problem would develop. I had to get out of there to follow up on that curb and sidewalk bid at the new shopping center. If I had lost that bigger order, that would have hit the fan, too. How did my “win” turn into a “loss”?

John’s internal conversation was different:

In the past couple of years I’ve really gone out of my way to help Steve and it seems one thing or another continues to go wrong. He refuses to keep up with the newer mix designs and additives and fights using the QC software program to its fullest extent. He’s smart enough to learn; he’s just too lazy and comfortable. I admit I have not told him that customers called reporting that he just hangs out at the site and is not as pro-active as other sales reps because I just didn’t want to hear his excuses since, somehow, Steve manages to always hit his quota - just enough to keep his job. ABC Contractors asked that Steve no longer be assigned to them yet Lenny still called Steve for this order. That I don’t get—maybe Lenny does not know Andy handles the account now. Yet, instead of taking my criticism and suggestions seriously, Steve rationalizes his actions as correct and others are the problem. That’s what really got me so angry. I’m tired of this. Today’s incident might create that liability which will be his ticket out the door, at 56, or not.

Let’s think about what was said and what was thought and felt by both men. They both agree that the mix delivered did not meet the spec. They also think each is correct in how they handled the situation and the other one is unreasonable. The question of who intended what is central to the issues. Additionally, intentions strongly influence our judgments of others.

Putting aside the actual technical issue are three key mistakes. First, both assumed he knew the other’s intentions. And in fact, more often than not, our assumptions are often wrong. That is because we form our view of the other’s intent based on the impact of his actions on us. Another human trait is that we typically assume the worst of the other party while treating our own intentions much more charitably. We believe the other party’s intentions are bad; we naturally come out swinging in self-defense. Finally, when we think others have bad intentions toward us, it affects our behavior: our behavior mimics how they treat us. It becomes a self-fulfilling prophecy; our assumption that they have bad intentions comes true.

The second mistake is that good intentions don’t negate a bad impact. The third is who is to blame.

These mistakes can be avoided. The first step is to recognize that there is a difference between the impact of one’s behavior and their intention. The second mistake is to recognize that the other person was frustrated/hurt/embarrassed. A critical way to let the air out of the balloon is to first verbally acknowledge his feeling, then return to the question of his intention. As for blame, it is the prominent issue in many difficult conversations.

Negotiation and mediation experts believe that focusing on blame is a bad idea because it inhibits our ability to learn what is really causing the problem and understand what should be done to correct it. The start is to look at how each party contributed to bringing about the current situation. That outlook is not as judgmental or backward looking but rather about understanding what happened, how people felt and how it impacted the identify of those involved. It’s a process that is forward-thinking.

Many difficult conversations have the specter of punishment, that is, drilling down to the truth. When punishment is part of the conflict dialog, people are less forthcoming, not as open, or willing to apologize. If the real goal is fixing what is broken, as in Steve’s case, modernizing and changing his sales competence to mitigate error, is a critical performance factor. Let’s assume firing Steve is warranted but if Steve and the rest of management think the problem is now fixed, they are wrong.

While the company got rid of one part of the system (Steve) that contributed to the expensive, litigated pour error, it should also examine the system as a whole. Is there a larger contribution of the process that caused the error? While Steve acted irresponsibly, John’s further investigation found that many sales reps kept silent though they believed that new pricing software package had flaws. Were there implicit directives or incentives that encouraged them to not speak up? What structures, policies and processes continue and what would it take to change them?

Conflicts move from episode to episode in a continually unfolding pattern of interactions. The moves and interpretations of each party influence others. Nowhere can we see more clearly the interlocking impact of moves and counter moves than in destructive conflicts. What makes good companies make the list of “great places to work” is that they take an extreme stance to use conflicts as constructive learning experiences embodied with a collaborative mindset.

Bibliography


Life Cycle Assessment of Concrete Buildings

Part I

Lionel Lemay, P.E., S.E., LEED AP, Senior Vice President, Sustainability
National Ready Mixed Concrete Association

Introduction

When it comes to commercial building construction, concrete offers several environmental benefits. For example, the production of concrete is resource efficient and the ingredients require little processing. Most materials for concrete are acquired and manufactured locally which minimizes transportation energy and associated greenhouse gas emissions. Concrete incorporates recycled industrial byproducts such as fly ash, slag and silica fume which helps reduce embodied energy, carbon footprint and waste. Concrete has a long service life, thereby increasing the period between reconstruction, repair and maintenance and associated environmental impacts. Because concrete is light in color it can help minimize the urban heat island effect when used as pavement for parking areas and plazas, or for exterior cladding.

Most importantly, because of concrete’s thermal mass, concrete buildings can be extremely energy efficient. From a life cycle perspective, concrete-frame buildings perform well when compared to steel-frame buildings. As a result, concrete buildings have lower carbon footprints over their entire life cycle. This paper explores how concrete performs for commercial buildings using life cycle assessment (LCA) methods of determining environmental performance.

What is Life Cycle Assessment?

Life cycle assessment, or LCA, is the investigation and evaluation of the environmental impacts of a product, process or service. LCA evaluates all stages of a product's life and considers each stage interdependently, meaning that one operation leads to the next. There are several life cycle stages for a given system or process. These stages can include, but are not limited to those shown in Figure 1. Inputs may include raw materials and energy. Life cycle stages may include raw material acquisition, manufacturing, building use or operations, and finally recycling or waste management. The outputs, many of which impact the environment negatively, include atmospheric emissions, waterborne wastes, solid wastes, coproducts and other releases.

When looking at the environmental impact of a building, it is important to assess every stage of the environmental life cycle: from material extraction, manufacturing and construction; building operations and the end-of-life stage where the building is demolished and reused or discarded. LCA, is the most comprehensive approach to determining the environmental life cycle impacts of a building and can be used as a tool to make design decisions that would result in lower environmental impacts.

Per the ISO 14040^1 and 14044^2 standards, LCA is conducted in four distinct phases:

1. **Goal Definition and Scoping** - Define and describe the product, process or activity being analyzed.
2. **Inventory Analysis** - Identify and quantify energy, water and materials use and environmental releases. Environmental releases may be solid waste, air emissions and waste water discharges.
3. **Impact Assessment** - Assess the potential human and ecological effects of energy, water and material usage and the environmental releases identified in the inventory analysis.
4. **Interpretation** - Evaluate the results and select the preferred product or process

The first phase, **Goal Definition and Scoping**, is relatively simple since one can generally identify and define the product or process being analyzed. The second phase, **Inventory Analysis**, is more difficult since one must have the capabilities to measure and account for all inputs and outputs from a particular product.
or process. In many cases, it is relatively easy to measure the inputs to a product or process but it becomes much more difficult and expensive to measure environmental releases.

The third phase, Impact Assessment, is the most complex phase of an LCA. In this phase, one attempts to equate the environmental releases identified in the Inventory Analysis phase and assess their potential human and ecological effects. The U.S. Environmental Protection Agency (EPA) developed the Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI). TRACI allows the examination of the potential for impacts associated with the raw material usage and chemical releases resulting from the processes involved in producing a product.

The purpose of TRACI is to allow a determination of priorities or a preliminary comparison of two or more options on the basis of several environmental impact categories, including ozone depletion, global warming, acidification, eutrophication, photochemical smog, human health issues, ecotoxicity, fossil fuel use, land use and water use. Figure 2 provides a schematic representation of potential environmental impacts and one possible interpretation of their relative importance for the purposes of identifying the most critical impacts. The relative importance of each impact might change depending on the product or process being analyzed or on other factors such as location and/or political influences. For example, many governments have declared climate change as today’s most important environmental impact. However, there are some locations where water is scarce and therefore water intake and waterborne releases may be more important.

There are inputs and outputs (releases) for each life cycle stage. For a building, energy and materials are consumed to manufacture building products. As a result, there are environmental releases and associated impacts. Similarly, there are inputs and environmental releases from the construction stage. For buildings, the use or operational life cycle stage impacts are significantly greater than those in the other life cycle stages. A building usually operates for decades consuming energy and raw materials with associated environmental releases. These operational stage impacts typically dwarf the environmental impacts from material extraction, manufacturing and end-of-life stages for commercial buildings.

Although it depends on the type of building and the impacts being measured, the operational stage impacts are typically 5 to 20 times larger than stages associated with building product manufacturing and demolition. In fact, operating buildings in the U.S. consumes 19% of the nation’s energy and 37% of the nation’s electricity. In total, commercial buildings account for 19% of the CO$_2$ emissions in the U.S. Therefore, when conducting an LCA for buildings, it is extremely important to include the operational stage.

**How Can Concrete Help Reduce Environmental Impacts of a Building?**

**Low Processing Energy**

Water, sand, stone, gravel and other ingredients make up about 90% of a concrete mixture by weight. The process of mining sand and gravel, crushing stone, combining the materials in a concrete plant and transporting concrete to the construction site requires very little energy and therefore only emits a relatively small amount of CO$_2$ into the atmosphere. The amount of CO$_2$ embodied in concrete is primarily a function of the cement content in the mix.

Cement is an ingredient of concrete. It’s the fine, gray powder that, when mixed with water, sand and gravel, forms the rock-like mass known as concrete.

Concrete uses between about 7% and 15% cement by mass depending on the performance requirements for the concrete. The average quantity of portland cement is around 250 kg/m$^3$ (420 lb/yd$^3$). This average quantity has consistently decreased with better optimization of concrete mixtures and increased use of supplementary cementitious materials (SCMs) that can improve the strength and durability characteristics of concrete. As a result, approximately 100 to 300 kg of CO$_2$ is embodied in every cubic meter of concrete (170 to 500 lb per yd$^3$) produced or approximately 5% to 13% of the weight of concrete produced, depending on the mixture proportions, which is relatively low when compared to other building materials.

Concrete also provides the distinct benefit of being a locally produced material. The use of locally manufactured materials reduces the environmental impact of transportation. In addition, using concrete that is produced and manufactured in the same community as the construction site supports the local economy.

**Recycled Materials**

The U.S. concrete industry uses a significant amount of industrial byproducts such as fly ash, blast furnace slag and silica fume to supplement a portion of the cement used in concrete. These industrial byproducts, which would otherwise end up in landfills, are called supplementary cementitious materials or SCMs for short. The use of SCMs in concrete work in combination with portland cement to improve strength and durability, in addition to reducing the CO$_2$ embodied in concrete by as much as 70%, with typical values ranging between 15 and 40%.

Fly ash is the waste byproduct of burning coal in electrical power plants. Generally, 15 to 20% of burned coal takes the form of fly ash. At one time, most fly ash was landfilled, but today a significant portion is used in concrete. Blast furnace slag is the waste byproduct of iron manufacture. After quenching and

**Figure 2. Environmental impacts and relative importance of impacts (adapted from USGBC).**

![Environmental impacts and relative importance of impacts](image-url)
grinding, the blast furnace slag takes on much higher value as a supplementary cementitious material for concrete. Blast furnace slag is used as a partial replacement for cement to impart added strength and durability to concrete. Silica fume is a waste byproduct of processing quartz into silicon or ferrosilicon metals in an electric arc furnace. It consists of superfine, spherical particles that when combined with cement significantly increases strength and durability of concrete.

The concrete industry also incorporates a variety of environmental best management practices in the production of its product. These include the reuse and recycling of waste from concrete manufacture such as water and unused returned concrete. It also incorporates waste byproducts from other industries such as recycled industrial wastewater, foundry sands, glass and other materials that would typically end up in landfills.

In addition to the use of SCMs in the concrete mix, concrete from demolition can be crushed and recycled as aggregate. Recycled aggregate is often used as backfill and pavement base and is sometimes used for making new concrete. Reinforcing steel in concrete (which often is made from recycled materials) can be recycled and reused.

Indoor Air Quality

Indoor air quality can directly impact the health of a building’s occupants. Poor indoor air quality can exacerbate asthma or cause irritation to eyes, nose and throat. Incidences of nose dryness often leads to nose bleeds, skin rash, headaches, upper respiratory distress and dizziness. Outdoor air quality has been regulated and has become cleaner; however, indoor air has deteriorated. The indoor air quality in our buildings may be two to five times more polluted than the outside air. Indoor air quality can be impacted by cigarette or tobacco smoke, high Volatile Organic Compound (VOC) levels due to materials used in laminate, particleboard, hardboard, treated wood, etc., carpeting and cleaning materials, among other building products.

Concrete has one of the lowest levels of VOC’s and off-gassing when compared to other commonly used building materials as shown in Table 1.

<table>
<thead>
<tr>
<th>Building Material</th>
<th>VOC Concentration, mg/m³</th>
<th>VOC Emission Rate, mg/m²/h</th>
</tr>
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<tbody>
<tr>
<td>Concrete with water-based form-release agent</td>
<td>0.018</td>
<td>0.003</td>
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<tr>
<td>Acrylic latex paint</td>
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</table>

Concrete, when used on the exterior envelope of the building, reduces the amount of air infiltration into the building, therefore reducing the amount of airborne moisture entering the building. This provides for better air quality, less chance of molds and more efficient use of HVAC systems.

Durability

Concrete structures can withstand the test of time. For a building to last for generations, durability must be an inherent quality of the construction materials. Concrete does not rust, rot or burn. Concrete used for buildings and pavements are durable, long-lasting structures. Because of its longevity, concrete is a viable solution for environmentally responsible design and requires less maintenance over the lifetime of the building. As a result, concrete buildings have low environmental impacts associated with maintenance and repair.

Stormwater Management

Improperly managed stormwater runoff can flow over impervious surfaces, picking up pollutants along the way and washing them into lakes, rivers and streams. Pollutants, such as heavy metals and sediment, can alter the basic natural habitats of several species and can result in the death of animals and organisms. Stormwater runoff has been traditionally controlled through the use of detention or retention basins which store the stormwater runoff and allow it to percolate through the soil below. Retention and detention basins take up a significant
A material's ability to reflect solar radiation is measured by the material’s albedo or measure of solar reflectivity. A material’s albedo is the extent to which the material diffusely reflects light from the sun. Although not always an indicator, materials with a light color have a high albedo whereas materials that appear darker typically have a lower albedo. A material’s ability to reflect infrared light is directly proportional to a material’s ability to reflect heat from the surface. During the hot summer months, the ambient air surrounding dark colored paving or cladding materials can be up to 10 degrees warmer than paving or cladding with a light color, or high albedo.¹⁰

One study measured the temperature of various pavement types during a hot 32 °C (90 °F) summer day and found that weathered concrete had a temperature of 68 °C (155 °F) at the material surface whereas dark asphalt had a temperature of 90 °C (195 °F). The asphalt pavement was 32 °C (40 °F) hotter than the concrete pavement.¹¹

The Urban Heat Island Reduction Program of the U.S. Department of Energy (DOE) provides several recommendations for reducing urban heat islands. The program suggests that by replacing dark colored pavements with light and heat-reflective concrete-based materials, along with careful planting of trees, the average summer afternoon temperature in urban areas can be significantly reduced. Researchers at Lawrence Berkeley National Laboratory (LBNL) have estimated that

**Thermal Mass**

Thermal mass is the term used to describe a material that absorbs and stores heat energy. In a building system, it is the mass of the building elements that stores heat during the hottest periods of the day and releases the heat during the cooler evening hours. Concrete is one of several building materials that possess thermal mass properties. In the winter season, high thermal mass concrete walls and floors absorb radiant heat from the sun and gradually releases it back into the occupied space during the night when the outdoor temperature drops. Concrete is an ideal building material for commercial and residential structures due to its high specific heat, high density and low thermal conductivity.

The distinct benefits of high thermal mass buildings are:

- Moderate shifts in peak loads of energy requirements due to the reduction in high fluctuations between indoor and outdoor temperatures.
- Heat transfer through a high thermal mass wall is reduced, therefore less energy is used to heat and cool the interior space.
- The thermal mass of concrete delays peak temperatures, and reduces and spaces out peak energy loads, therefore shifting the energy demand to off peak periods when utility rates may be lower.

The damping and lag effects of a high thermal mass building are shown in Figure 4.

**Urban Heat Island Reduction**

On warm summer days, the air in urban areas can be 3-4 °C (6-8 °F) hotter than its surrounding areas. This is called the urban heat island effect (see figure 5).¹² The use of light colored pavements, cladding and roofing in our urban areas can contribute to overall energy savings and reduced carbon emissions. Because concrete is light in color, it absorbs less heat and reflects more light than dark-colored materials, therefore maintaining a relatively low surface temperature. Concrete has been demonstrated to have a positive impact on the localized ambient temperatures and can reduce energy required to air condition buildings.

Pervious concrete pavement is a unique and innovative means to manage stormwater. A pervious concrete mixture contains little or no sand, creating a substantial void content. Using sufficient paste to coat and bind the aggregate particles creates a system of highly permeable, interconnected voids that drains aggregate particles creates a system of highly permeable, interconnected voids that drains it in its natural state. Typically, between 15 and 25% voids are achieved in the hardened concrete. Pervious concrete has been used successfully in many types of applications such as parking lots, streets, plazas, nature trails and walkways.

**Figure 3. Pervious concrete has between 15 and 25% voids that allow stormwater to percolate through it.**

Pervious concrete pavements are typically supported on a base layer of uniformly sized stone to form a basin where rainwater can be stored before percolating into the soil below. The system basically forms a dry detention pond which can reduce the need for expensive stormwater drainage and wet pond detention/retention systems, thereby allowing for more effective land use. In effect, the pervious concrete pavement system serves two functions: 1) as a paved surface for driving, parking or walking, and 2) as a retention basin for storing rainwater during a storm event.

Pervious pavement systems can treat common pollutants found in the urban environment. Pollutants are those typically found on parking areas, including cadmium, oils, lead and gasoline among others. The pollutants are captured in the voids of the pervious concrete and the treated water is filtered into the groundwater below. The oil-based pollutants that are stored in the voids of the pervious pavement are digested by naturally occurring microorganisms that inhabit the large surface area surrounding the voids.⁸

**Figure 4. Damping and lag effect of thermal mass.**
every 10 percent increase in solar reflectance could decrease surface temperatures by 4 °C (7 °F). Further, they predicted that if pavement reflectance throughout a city were increased from 10 percent to 35 percent, the air temperature could potentially be reduced by 0.6 °C (1 °F) which would result in significant benefits in terms of lower energy use and reduced ozone levels. Another separate study estimated over $90 million per year in savings from temperature reductions attributed to increased pavement albedo in the Los Angeles area.

Depending on the electric power fuel mix, decreased energy demand associated with cool pavements will result in lower associated air pollution and greenhouse gas emissions. Cooler air temperatures also slow the rate of ground-level ozone formation and reduce evaporative emissions from vehicles. A 2007 paper estimated that increasing pavement albedo in cities worldwide, from an average of 35 to 39 percent, could achieve reductions in global carbon dioxide (CO₂) emissions worth about $400 billion.

Reduced Lighting Requirements

Using concrete for pavements can also help reduce energy demand for lighting. A research study analyzed the lighting required to meet specified luminance for an asphalt and a concrete parking lot. Results indicate that a 250 Watt lamp used in a concrete parking lot would produce background luminance equal (or greater) to a 400 Watt lamp used in an asphalt parking lot with the same geometric configurations. Therefore, by using a concrete parking surface, energy savings of up to 41% could be realized. With the assumption that an average parking lot lighting system operates up to five hours per day, in one year the asphalt parking lot would consume 60% more energy than the concrete parking lot. In addition, with the increased luminance of a concrete parking lot, the number of light poles can be reduced.

Research Examples of LCA of Buildings

There are relatively few examples of LCAs of commercial buildings in the literature. LCA is still a relatively new science and can be extremely time consuming and expensive to conduct. Most researchers have only conducted partial LCAs and choose to limit the scope of an LCA by ignoring certain life cycle stages because of the lack of data or scope of research. Others focus on specific impacts to simplify the LCA process. Be sure to visit the digital edition of Concrete InFocus at www.nrmca.org to read the rest of this article and for a list of references.
Sustainability & Regulations — IS There a Link?

By Douglas E. Ruhlin, CCPf, LEED Green Associate
Environmental / Sustainability Consultant, Resource Management Associates

There’s a lot of talk today about sustainability within the concrete industry, which is good since it focuses attention on the product (ready mixed concrete and concrete products) as the most sustainable building material on the planet and on its use in sustainable building practices such as in LEED certified projects. The third link in this sustainability picture, after the product and sustainable utilization process itself, is the concrete plant. Now, attention is being focused on the sustainability of the concrete plant itself, primarily through the new NRMCA Sustainable Plant Guidelines and certification program.

As part of the NRMCA Sustainable Plant certification, a concrete plant must certify (among other requirements) as a prerequisite, that it is in compliance with all applicable federal, state and local environmental regulations. While not typically what we might think of as “sustainable,” there is a clear link between sustainability and environmental regulatory compliance (and perhaps compliance with other regulations as well). How can a concrete plant claim to be sustainable if it cannot clearly demonstrate that it operates in accordance with all mandated applicable environmental guidelines (i.e., regulations)? While sustainability goes far beyond the baseline of environmental compliance, clearly present and continuing adherence to this baseline is (and ought to be) a continuing pre-requisite to any claims to operating a sustainable concrete plant.

This can be a tall order. First, a concrete plant must determine what regulations are applicable to the plant on a federal, state and local level. For many concrete plants, this may be beyond the current knowledge level of the plant operator. In this situation, it is critical that the plant recognize the inherent limitations and obtain knowledgeable, qualified assistance wherever possible. This step requires a concrete plant to fully develop the listing of environmental regulations that are applicable to the plant, as well as a clear understanding of why others may not be possible. This is important, since many regulatory programs that may be applicable to the concrete plant may not be completely understood by many within the industry — something could be missed! Next, a concrete plant needs to evaluate its current compliance level against this background of regulatory requirements. This step requires a plant to determine whether it is fully in compliance with all aspects of the regulations — partial compliance is not good enough! For example, if a concrete plant has an NPDES discharge permit, but lacks a required program of SWP3 implementation, inspections and recordkeeping, then it is not compliant. The most common way to accomplish these first two steps is to undertake a comprehensive regulatory compliance audit, performed by trained knowledgeable employees with full understanding and support of management and corporate legal counsel. Finally, if at that point the evaluation determines that the concrete plant is fully compliant with all applicable regulations, the plant can certify that it is in compliance.
It’s important to recognize that compliance is not just a snapshot in time – it’s a continuing situation. To be in compliance today does not guarantee compliance tomorrow. Regular compliance evaluations should be undertaken to ensure continuing compliance.

Regulatory compliance is critical to sustainability. It demonstrates a plant’s commitment to the environment. It also develops the baseline from which sustainable practices can grow, above and beyond the scope of environmental regulations. For example, a concrete plant could be in compliance with its NPDES stormwater discharge permit, which might for example permit the discharge of all stormwater associated with industrial activity from the site. At this point, the facility can certify it is in compliance with this requirement (provided it meets all permit conditions and obligations). However, true sustainability suggests that there may be practices above and beyond this baseline compliant condition that could be implemented at the concrete plant, such as stormwater harvesting (capture and containment) for use in concrete batching or other uses around the plant. Environmentally compliant, yes, but above and beyond the baseline of environmental regulations.

Environmental compliance can also significantly hurt a concrete plant’s claims of sustainable practices. If a concrete plant which claims to be compliant / sustainable (and which may have received certification of same) is found to be in violation of some significant environmental regulation, not only is the underlying claim of compliance in serious jeopardy, but also the facility’s claims of operating a sustainable plant in general. In other words – determine your compliance level carefully, and if found to be in compliance, make every possible effort to stay there. Recognized failure to maintain compliance can significantly hinder a concrete plant’s sustainability program, at least in terms of perception of the claims made by the facility.

Environmental compliance is not an impossible goal for a concrete plant – it can be achieved and maintained. From that baseline an exciting world of sustainable plant practices can be explored. But lacking that baseline puts a plant’s sustainability efforts at a serious disadvantage right from the start.

For further information on any of the issues in this article, Doug Ruhlin can be contacted at Resource Management Associates, PO Box 512, Forked River NJ 08731; (609) 693-8301; www.resourcemanagementassoc.com or via email at druhlin@resourcemanagementassoc.com.

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I heard that under a Letter of Interpretation, OSHA will be requiring me to engineer a reduction in noise levels instead of using ear plugs. Is this true?

The correct answer is yes and no. OSHA did publish a new letter of interpretation on October 19, 2010 requiring companies to engineer noise down to acceptable levels unless it threatened to put the company out of business. This letter of interpretation has recently been withdrawn and the Agency will instead:

- Conduct a thorough review of comments that have been submitted in response to the Federal Register notice and of any other information it receives on this issue;
- Hold a stakeholder meeting on preventing occupational hearing loss to elicit the views of employers, workers, and noise control and public health professionals (meeting date and time are have yet to be set);
- Consult with experts from the National Institute for Occupational Safety and Health, and the National Academy of Engineering; and
- Initiate a robust outreach and compliance assistance effort to provide enhanced technical information and guidance on the many inexpensive, effective engineering controls for dangerous noise levels.

Thousands of workers every year continue to suffer from preventable hearing loss due to high workplace noise levels. Since 2004, the Bureau of Labor Statistics has reported that nearly 125,000 workers have suffered significant, permanent hearing loss. In 2008 alone, BLS reported more than 22,000 hearing loss cases. The Department of Labor emphasizes that OSHA remains committed to finding ways to reduce this toll.

Please note: The column contained here should in no way be considered a substitute for competent legal counsel. It is only meant as a guide to help employers know when it is necessary to consult an attorney on issues pertaining to labor-management relations and other workplace issues.

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DRIVING TRANSMISSION TECHNOLOGY®
Life Cycle Assessment of Concrete Buildings

Part II

Lionel Lemay, P.E., S.E., LEED AP, Senior Vice President, Sustainability
National Ready Mixed Concrete Association

Environmental Effects of Steel- and Concrete-Framed Buildings

Guggemos and Horvath published a paper titled Comparison of Environmental Effects of Steel- and Concrete-Framed Buildings in the *Journal of Infrastructure Systems*, ASCE, 2005.16 The objective of the paper was to identify and quantify the energy use and the environmental emissions during the construction stage of two typical office buildings, one with a structural steel frame and one with a cast-in-place concrete frame, and then put these environmental loadings in the larger perspective of the overall life cycle of each building. Concrete and steel frames were chosen because they are two of the most commonly used structural materials for commercial buildings. Knowing the total life cycle energy use and emissions would allow a decision maker to form an objective comparison of the two building types.

The functional unit selected was a 4,400 m² (47,361 ft²), five-story building, designed to reflect a typical office building. It is located in the midwestern U.S. and expected to be used for 50 years. The building has concrete mat foundations, aluminum-framed glass panel curtain walls, and built-up roofing. The interior finishes include painted partition walls, acoustical drop ceilings, and carpet or ceramic tile flooring. The mechanical systems provide both heating and cooling. The only difference between the two buildings is the type of structural frame: steel or concrete. The steel structure includes special moment-resisting frames and braced frames. The floor slabs are lightweight concrete over steel decking. The concrete structural frame consists of reinforced-concrete columns, beams, shear walls and slabs.

<table>
<thead>
<tr>
<th></th>
<th>Energy (10^6 GJ)</th>
<th>CO2 (mt)</th>
<th>CO (kg)</th>
<th>NO2 (kg)</th>
<th>PM10 (kg)</th>
<th>SO2 (kg)</th>
<th>VOC (kg)</th>
<th>HC (kg)</th>
<th>Cr(VI) (g)</th>
<th>Ni (g)</th>
<th>Cr (g)</th>
<th>Mn (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel Frame</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Concrete Frame</td>
<td>1500</td>
<td>1500</td>
<td>1500</td>
<td>1500</td>
<td>1500</td>
<td>1500</td>
<td>1500</td>
<td>1500</td>
<td>1500</td>
<td>1500</td>
<td>1500</td>
<td>1500</td>
</tr>
</tbody>
</table>

*FIGURE 6. Construction stage inventories of steel- and concrete-frame buildings.*
Figure 6 shows the construction-stage energy inputs and environmental releases of the two structural frames separately from the total building construction-stage impacts because the structural frames are the only difference between the two buildings in the construction stage. The concrete structural frame has more associated energy use, CO$_2$, CO, NO$_2$, particulate matter smaller than 10 micrometers, SO$_2$ and hydrocarbon emissions due to more temporary materials, particularly formwork, larger transportation impacts due to a larger mass of materials and longer equipment use due to the longer installation process. On the other hand, the steel frame is higher in volatile organic compound and heavy metal (Cr, Ni, Mn) emissions due to the painting, torch cutting and welding of the steel members.

By contrast, the total life-cycle effects of the buildings over 50 years of service life are shown in Figure 7. If the two buildings are compared over their entire life cycles, the differences noted in the construction stage disappear and the use stage impacts dominate. For example, for the steel-frame building, the use stage impacts account for 82% of the energy use, 67% of the NO$_X$ emissions, 83% of the SO$_2$ emissions and 84% of the CO$_2$ emissions. For the concrete frame building, the use stage accounts for 83%, 64%, 84% and 85% of the same effects, respectively.

By further disaggregating energy use into the different life cycle stages as shown in figure 8, a comparison of the materials, construction and end-of-life stages for the two buildings reveals that although the concrete frame is heavier and takes longer to install and demolish, the steel manufacturing process is more energy intensive. Energy consumption in the use and maintenance stages was assumed to be the same for each building, which is generally not true since all other things being equal, a concrete frame building is more energy efficient then a steel frame building due to increase thermal mass.

The extra energy used for steel production in the materials-manufacturing stage for the steel-frame building approximately outweighs the increased energy used for the construction and end-of-life stages for the concrete-frame building. Therefore, although the steel frame appeared to be the better choice when studying the construction stage, an environmentally preferable choice is not so clear when looking at the total life cycle effects.

When considering the total life cycle energy use and emissions of steel- and concrete-framed buildings, the results are comparable. The extra energy and emissions spent manufacturing the structural steel as compared to the concrete
Table 2. Building configurations evaluated for energy consumption.

<table>
<thead>
<tr>
<th>Designation*</th>
<th>Exterior walls</th>
<th>Structural frame</th>
<th>Floors</th>
<th>Interior walls</th>
</tr>
</thead>
<tbody>
<tr>
<td>EL (baseline)</td>
<td>EIFS &amp; metal stud</td>
<td>structural steel</td>
<td>concrete on metal deck</td>
<td>metal stud</td>
</tr>
<tr>
<td>CL</td>
<td>curtain wall</td>
<td>structural steel</td>
<td>concrete on metal deck</td>
<td>metal stud</td>
</tr>
<tr>
<td>ML</td>
<td>precast concrete</td>
<td>structural steel</td>
<td>concrete on metal deck</td>
<td>metal stud</td>
</tr>
<tr>
<td>EM</td>
<td>EIFS &amp; metal stud</td>
<td>reinforced concrete</td>
<td>12” (300 mm) solid concrete</td>
<td>reinforced concrete</td>
</tr>
<tr>
<td>CM</td>
<td>curtain wall</td>
<td>reinforced concrete</td>
<td>12” (300 mm) solid concrete</td>
<td>reinforced concrete</td>
</tr>
<tr>
<td>MM</td>
<td>precast concrete</td>
<td>reinforced concrete</td>
<td>12” (300 mm) solid concrete</td>
<td>reinforced concrete</td>
</tr>
<tr>
<td>MLX</td>
<td>precast concrete</td>
<td>structural steel</td>
<td>concrete on metal deck</td>
<td>metal stud</td>
</tr>
<tr>
<td>MMX</td>
<td>precast concrete</td>
<td>reinforced concrete</td>
<td>12” (300 mm) solid concrete</td>
<td>reinforced concrete</td>
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<tr>
<td>MMI**</td>
<td>precast concrete</td>
<td>reinforced concrete</td>
<td>12” (300 mm) solid concrete</td>
<td>reinforced concrete</td>
</tr>
<tr>
<td>MMIXI**</td>
<td>precast concrete</td>
<td>reinforced concrete</td>
<td>12” (300 mm) solid concrete</td>
<td>reinforced concrete</td>
</tr>
</tbody>
</table>

**High internal load equipment placed near the central core of the building.

are comparable to the extra energy and emissions used to construct and ultimately demolish the concrete frame.

Overall, the large use stage environmental effects dwarf every other life cycle stage. For the overall building life cycle, the construction stage impacts represent a relatively small part (0.4–11%) of the overall building life cycle energy use and emissions. The maintenance and end-of-life stages also tend to have small contributions to total energy use and emissions. The building use stage contributes the most energy use impacts. This study did not take into account the differences in energy savings over a building’s lifetime from thermal mass and other potential savings such as urban heat island reduction and lighting reduction.

Modeling Energy Performance of Concrete Buildings

Marceau and VanGeem conducted research to determine the energy cost savings of concrete-frame buildings versus steel-frame buildings.17 The researchers conducted dynamic whole building energy simulations in six climate zones using DOE2.1E software. They measured energy consumption for a typical 5-story building with 10 different configurations of exterior walls, structural frames, floors and interior walls as shown in Table 2.

First, the energy analysis was conducted for a baseline building (designation EL in table 2) as defined in ASHRAE 90.1.18 The base building comprises common, lightweight assemblies with roof insulation entirely above the deck. Above-grade walls are built of metal studs and with exterior insulated finish system (EIFS). Floors are concrete on metal deck supported by steel-joists. The window-to-wall ratio was 0.40 and roof reflectivity was 0.30.

Results show that in all cases, the MMX concrete building simulation (see Table 2) demonstrated the lowest energy costs in all six climate zones. The MMX building simulation comprised of precast concrete exterior walls exceeding code, reinforced concrete frame, concrete floors and reinforced concrete interior walls for the building core. Figure 9 provides the cost saving of the MMX building simulation over the EL (base building) for the six different climate zones evaluated. Savings range from 5 to 9% for warm climates like Miami and Phoenix respectively, 16% for a mild climate like Memphis, 18 to 21% for cold climates like Chicago and Denver respectively and 23% for cool climates like Salem, Oregon.

Life Cycle Assessment of Buildings at the Massachusetts Institute of Technology

The Massachusetts Institute of Technology (MIT) Concrete Sustainability Hub has recently conducted LCA studies of
large commercial buildings. The studies are measuring Global Warming Potential (GWP) of steel and concrete buildings. Greenhouse gas emissions are represented in carbon dioxide equivalence, or CO₂e.

The researchers focused on investigating the role of thermal mass in reducing energy consumption and associated carbon emissions of large office buildings. They compared buildings with higher thermal mass (concrete) and lower thermal mass (steel). They evaluated a steel building and a concrete building based on the large commercial office building model provided by DOE. The building model used was a 12-story, approximately 46450 m² (500,000 ft²) rectangular office building 76.2 m by 50.3 m (250 ft by 165 ft). Both building facades consist of 40% glazing and 60% aluminum panels. The foundation is concrete slab-on-grade.

The researchers used EnergyPlus software to calculate the energy requirements of the two building designs for two different climates, a warm climate (Phoenix) and cold climate (Chicago). The research results show that added thermal mass in conventional office buildings due to the use of concrete construction over steel construction provides annual energy savings in heating, cooling and ventilation (HVAC) of 6% in Phoenix and 5% in Chicago. These savings can accumulate to provide significant carbon savings throughout the life cycle.

The researchers are continuing their LCA work on commercial office buildings by incorporating a range different variables in the energy models. They plan to evaluate the following:

- Varying envelope assemblies
- Varying building configurations to take advantage of concrete’s thermal mass properties
- Investigating the impact of passive heating and cooling technologies
- Estimating the impact of heat island effect on building energy consumption
- Considering additional climatic zones in the U.S.

Conclusion

Environmental life cycle assessment is a valuable tool for assessing the environmental impact of buildings. It is extremely important to include the operational stage of a building life cycle since the operational stage impacts dwarf the impacts of material extraction, manufacturing, construction and end-of-life life cycle stages. LCA provides a scientific approach to evaluating the merits of design alternatives. For the few LCAs conducted that compare the environmental impacts of steel- and concrete-framed buildings, it has been demonstrated that concrete buildings can offer energy savings and significant reductions in carbon emissions. Concrete building systems combine insulation with high thermal mass and low air infiltration to make buildings more energy efficient, therefore reducing the environmental impacts of buildings over their entire life cycles.

References


Water Demand – What is it and what’s it used for?

Part II

By Fernando Rodriguez, Rowen Concrete, Inc. and Jack Hoy, Swope & Associates (SIKA Admixtures)

As we mentioned in the previous article, the water demand is very critical to the overall mix design performance. Knowing the water demand is equally important for mix economics. A comprehensive water demand program should be established and the data should be utilized to optimize mixes on a monthly basis. Your plant operator may inadvertently exceed the water/cement ratio, which will cause a myriad of problems such as low strengths, extended set times, loss of durability and problems with finishability.

At a minimum, the water demand test in conjunction with the unit weight tests can help adjust yields for your most popular mixes. The most common yield is 27.1 cubic feet. It is just as important to not under yield as it is to over yield. As ready mix producers, we don’t want to short a customer and we certainly don’t want to give away our products.

The mix used for this article is listed below. We used portland cement only. No supplementary products such as fly ash or slag were used. Based on experience, we have seen that fly ash and slag greatly improve the slump characteristics of the concrete. Concrete that contains 15% fly ash or 35% slag react quite differently than concretes containing 100% portland cement. You can realize some slump enhancement by replacing a percentage of cement with a supplementary cementitious material.

In the original mix (Table 1), we did not use air entraining admixtures. Air entraining admixtures also enhance the slump characteristic of concrete.

The first test batch was performed in the laboratory with the exact amount of water mentioned above. However, the slump attained was measured to be ¾ inch, as seen in Figure 2. The batch was discarded and no compressive strength specimens were fabricated. The purpose of this first batch was merely to obtain a starting point for the water content. The water content “starting point” will vary for all ready mix companies, depending on the constituent materials available to that producer. The quality control manager/engineer will have a good assessment to establish the starting water point.

Three additional batches were mixed in the laboratory. The first batch contained water only, the second batch contained a Type A water reducer, and the third batch contained a Type-A water reducer and a Type-F high range water reducer. All tests were performed in accordance with ASTM standards. Both authors are ACI Grade I certified. A good slump was obtained with both the Type A and Type F water reducers.

The slump was measured at 4.5 inches with only 265 lbs (31.8 gallons) of water.

The actual water totals used in the batches, the achieved slump, the actual water to cement ratio, the amount of water reducers used and the 28-day compressive strength results are listed below in Table 2.

As was expected, the more water that is added to the batch, the lower the overall compressive strength of the concrete. Figure 1 compares the water to cement ratios to the 28-day compressive strength of the concretes produced in the laboratory. For purpose of this article, we fabricated 28-day test specimens only. However, your quality control manager/engineer should make 7, 14 and 28 day strength specimens. We recommend the three ages so that the strength development of that particular mix design can be tracked.

It is very important to know the water demand for the sand used in your concrete production. As you can see, it is not difficult to determine the water content. All the testing performed lasted approximately 2 hours. All aggregates were placed in the laboratory and covered with plastic overnight. We attempted to maintain the same moisture content as the aggregates in the production stockpile. The cement and admixtures were collected from the plant.

Not knowing your water demand may cost money due to unnecessary additions of cement and/or admixtures. If a mix is not

---

Table 1

<table>
<thead>
<tr>
<th>Material</th>
<th>SP GRAV</th>
<th>SSD Wts per cubic yard(lbs)</th>
<th>Absolute Volume(cf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>3.15</td>
<td>564</td>
<td>2.87</td>
</tr>
<tr>
<td>SSD Stone</td>
<td>2.87</td>
<td>1800</td>
<td>10.05</td>
</tr>
<tr>
<td>SSD Sand</td>
<td>2.59</td>
<td>1454</td>
<td>9.00</td>
</tr>
<tr>
<td>Mixing Water</td>
<td>1.00</td>
<td>264</td>
<td>4.23</td>
</tr>
<tr>
<td>Air,%</td>
<td>3.00</td>
<td></td>
<td>0.81</td>
</tr>
</tbody>
</table>
properly design or produced, you would develop major problems after placement, such as low strength concrete. Properly training your concrete delivery professionals to alert you when excessive amounts of water are required to attain a given slump can intercept issues before they become problems.

<table>
<thead>
<tr>
<th>Set No.</th>
<th>UOM 862</th>
<th>864</th>
<th>865</th>
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</thead>
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<tr>
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<td>284</td>
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<tr>
<td>w/c</td>
<td></td>
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<td>0.50</td>
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<tr>
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<td>oz/cwt</td>
<td>0</td>
<td>5.0</td>
</tr>
<tr>
<td>Type F HRWR</td>
<td>oz/cwt</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Slump</td>
<td>inch</td>
<td>4.5</td>
<td>4.0</td>
</tr>
<tr>
<td>28-Day Avg</td>
<td>psi</td>
<td>4803</td>
<td>5865</td>
</tr>
</tbody>
</table>

It is important to know the water demand of your sand in order to select a cement content that is not only economic but also responsible. During the current economical downturn, quality control manager/engineers are being asked to “optimize” mix for cost savings. It is certainly our obligation to our employer to be fiscally economical with our mix designs; however, it is our responsibility to public safety to be responsible with the optimized mix. We must always keep in mind the requirements outlined in ACI 318, Chapter 5, and use Table 3 for your designs.

Knowing your water demand will not only help you save money, but will save you many headaches. The test is easy to perform and will help you adjust your mixes for peak performance. Establish a program and update your water demand as much as possible. Keep in mind that quality assurance is connected to quality control.

For more information, contact Mr. Rodriguez at concretemechanics@gmail.com.

When the citizens in and around Nashville, TN, see an Irving Materials ready mix truck rolling by, they undoubtedly think of concrete. And while no other association would come as readily to mind, the staff at local charity Our Kids might view the company quite differently - maybe with angels’ wings on the side of each mixer truck and company President John Curtis with a halo above his head.

That’s because since 2002, IMI-Tennessee led by Curtis has supported Our Kids Clinic, which provides medical evaluations and crisis counseling for children and families struggling with the trauma of child sexual abuse. Since IMI became the lead sponsor of the annual Kids Klassic Golf Tournament IMI employees have raised over $500,000 to support the charity. Irving Materials’ employees serve on the planning committee that meets regularly from May until the event is held in early October. Once the tournament begins, employees are on the golf course unloading and organizing supplies and helping Our Kids staff prepare for the 256 players registered for the event.

“Our champions at IMI help ensure that children and families find help, hope and healing, and the community is strengthened by having the very best services for its children,” said Sue Fort White, executive director of Our Kids, Inc. “IMI exemplifies the best of what can be accomplished when generosity, passion and resourcefulness are committed in service to the most vulnerable among us.”

In its 23-year history, Our Kids has examined more than 18,000 children and currently services 44 counties in Middle Tennessee. Since Curtis has served on the organization’s Executive Committee and also during his time as chairman of its board, the organization has added three satellite clinics in the communities of Cookeville, Lawrenceburg and Clarksville. Through the course of Irving Materials’ involvement, more than 50 employees from four states have donated thousands of hours of their time to support Our Kids.

An NRMCA producer member, Irving Materials has also recruited a host of other companies and organizations to help support Our Kids, including the Tennessee Concrete Association, Lehigh Cement, BASF, Holcim, CEMEX and Lafarge North America. All told, about 100 companies are involved in support of Our Kids, said
Fort White. Judging from letters submitted in support of Irving Materials’ nomination to receive the Concrete Cares Award, each company was more than happy to lend its support to the cause.

“At first, Lafarge began its involvement out of commitment to John, later after being involved in the imi Our Kids Golf Tournament as a major sponsor we saw it was much larger than John,” wrote Lafarge Vice President of Sales & Marketing Wade Herguth. “My personal commitment to Our Kids will continue and that of Lafarge will as well and this is all due to imi and John’s continued effort to Our Kids.

“When you and Irving Materials asked Grace to get involved with the Our Kids Center through participation in the Our Kids Klassic Golf Tournament, I could not think of a better cause to support,” wrote Grace Construction Products’ Mike Philipps, director of sales – global key accounts. “As a father of four young children, I applaud the work that the Our Kids Center does for children and their families to protect them from sexual abuse.”

Irving Materials’ support has even extended when the unexpected occurs. In May 2010, floods damaged much of Nashville, including the entire lower level of the Our Kids’ building. Irving Materials responded by loaning personnel and equipment to help the cleanup efforts. Fort White praised Curtis for helping to manage the paperwork with insurance companies and recruiting industry colleagues to redesign the outside of the building to include pervious concrete and concrete curbs to prevent a recurrence.

“They even built the staff a patio so they could have a beautiful place to relax after an especially difficult day in the clinic,” Fort White said.

Irving Materials at a Glance

Irving Materials, or IMI as it’s more commonly known, was founded in 1946 by C.C. Irving as a building materials supplier. Since then it has grown into a privately held, employee-owned corporation with company headquarters in Greenfield, IN, and four regional operation centers in Greenfield and Evansville, IN, Louisville, KY and Nashville, TN. It has about 2,400 employees. Products include ready mixed concrete, aggregate, turf and golf course products, and calcium-based products such as animal feed additives and mineral filler.
Repair Shop Safety

Part III

David Ayers, CHMM, CSP,
MS VP of HSE

Repair shops are often out of sight and out of mind at a ready mixed concrete facility. There are a variety of accidents that can happen in repair shops. One of the more overlooked issues is the transfer of flammable and combustible liquids. Given the right conditions, the transfer of flammable liquids can add to the injury and fire potential at a plant. It’s also very important that any spilled liquids are cleaned up immediately to not only lessen the fire potential, but these fluids are extremely slippery and add to the ready mixed concrete’s greatest injury potential in the form of slips, trips and falls. This article is Part III and the final article in the Repair Shop Safety series.

The storage of flammable and combustible liquids is extremely important. Open flames, smoking, static electricity, cutting and welding, hot surfaces, electrical and mechanical sparks and lightning are all sources of ignition of flammable and combustible liquids. All these sources of ignition with the exception of lightning can be controlled through the proper use and storage of flammable and combustible liquids. Buildings and silos should be adequately grounded in case of a lightning strike.

This fluid transfer can also generate static electricity. Static electricity can be generated by the contact and separation of dissimilar materials. For example: belts and pulleys, tires and the road, fluid flowing through a pipe, agitation and mixing of fluids, and splash filling of flammable liquids. One of the primary means of reducing the hazard of static electricity when transferring flammable liquids into/from containers is through the use of bonding and grounding. Bonding or grounding of flammable liquid containers is necessary to prevent static electricity from causing a spark.

Bonding of containers - Physically connect two conductive objects together with a bond wire to eliminate a difference in static charge potential between them. There must be a bond wire between containers during flammable liquid filling operations, unless a metallic path between them is otherwise present. Both objects bonded share the same charge and have no potential difference, BUT there still is a potential difference between the conductive objects and ground. Thus, there is danger of a spark from one of the conductive objects to grounded objects.

Grounding of containers - A ground wire eliminates a difference in static charge potential between conductive objects and ground. Although bonding will eliminate a difference in potential between objects, it will not eliminate a difference in potential between these objects and earth unless one of the objects is connected to earth with a ground wire. Both objects bonded and grounded permit charge to flow to ground.

The image on this page is a practical example. Here we have a 55-gallon drum used for dispensing a flammable liquid. Notice the bonding wire between the drum and the container (safety can). Next, there is a grounding wire between the drum and the ground. Finally there is a safety vent in the drum (not shown in picture). All together, this greatly reduces the chances of static electricity building up and sparking, causing a fire/explosion to start.

Finally, it cannot be emphasized enough that the improper storage of flammable and combustible liquids contributes greatly to a ready mixed concrete plant’s fire potential along with environmental liability (not mentioned in this article). Flammable and combustible liquids are a vital component in keeping the mixers running but proper storage and transfer is a must. These substances not only cause a potential for fire and explosion but are very slippery and have contributed to many slip, trip and fall accidents, the number one injury in the ready mixed concrete industry.