CANADIAN CIVIL ENGINEER
L'INGÉNIEUR CIVIL CANADIEN
civil

Sustainable Materials for Green buildings

Des matériaux durables pour des bâtiments verts

SPRING / PRINTEMPS
2012
29.1

Scan here to watch a video and learn more.
Balayez ici pour regarder une vidéo et en savoir plus.
WANTED:
ENGINEERS AND TECHNICIANS
"I've always enjoyed helping others. Now I have the opportunity to do just that. Whether helping out with flood relief, or building a school where there was none, I know I'm making a difference."
2nd Lieutenant JAMES KIM
RECHERCHONS :
INGÉNIEURS ET TECHNICIENS
« J'ai toujours voulu venir en aide aux autres. Et c'est exactement l'occasion qui m'est donnée ici. Que ce soit en participant aux efforts de reconstruction après une inondation ou en érigeant une école où il n'y en avait pas avant, je sais que je peux faire une différence. »
Sous-lieutenant JAMES KIM
FORCES.CA
JOIN US
1-800-856-8488
ENGAGEZ-VOUS
Canada

civil

features

columns

civil

29.1

The *Canadian Civil Engineer* (CCE) ISSN 9825-7515 is published five times per year by the Canadian Society for Civil Engineering (CSCE).

L'Ingénieur civil canadien (ICC) ISSN 9825-7515 est publié cinq fois par année par la Société canadienne de génie civil (SCGC).

CSCE / SCGC
4877 Sherbrooke St. W.
Westmount, Québec, H3Z 1G9
Tel: 514-933-2634 Fax: 514-933-3504
E-mail: info@csce.ca
www.csce.ca

CSCE Office / Office de la SCGC
President / Président
Randy Pickle, P.Eng., FCSCE (Oshawa, ON)

President Elect / Président désigné
Jim Kells, Ph.D., P.Eng., FCSCE (Saskatoon, SK)

Annual Subscription Rates / Abonnement annuel
Canada & U.S.A. $35.00
other countries / autres pays $45.00
single copy / au numéro $7.50
agency discount / rabais aux distributeurs 10%

Design / Production
AN Design Communications (Ottawa, ON)
613-744-0444
www.an-design.ca

Advertising / Publicité
Dovetail Communications Inc.
T: 905-886-6640
F: 905-886-6615
Beth Kukkonen 905-886-6641 ext. 306
E: bkukkonen@dvtail.com

The opinions expressed in the papers are solely those of the authors and the Canadian Society for Civil Engineering is not responsible for the statements made in this publication.

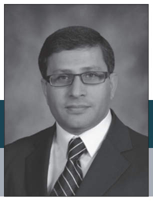
Les opinions exprimées dans les articles sont la seule responsabilité de leurs auteurs et la Société canadienne de génie civil n'engage pas sa responsabilité dans les propos exprimés.

All commentaries and questions about this publication should be forwarded to the Editor:
Pour vos commentaires ou de plus amples informations, contacte la rédactrice :
Louise Newman, louise@csce.ca 514-933-2634 ext. 23

Return Address / Adresse de retour :
The Canadian Society for Civil Engineering
La Société canadienne de génie civil
4877 Sherbrooke St. W., Westmount, Québec H3Z 1G9

FROM THE EDITOR / MOT DU RÉDACTEUR

MEDHAT SHEHATA PHD., P.ENG., RYERSON UNIVERSITY



Sustainability and our Role as Civil Engineers

Our role as Civil Engineers has always been responsive to the needs of our society. At the present time, one of the most pressing needs is to build sustainable structures. In fact, the concept of sustainability is not limited to structures—the real need is to build sustainable communities. Conservation of energy and non-renewable resources, reuse and recycle, and reducing carbon dioxide emissions are basic measures that aim at achieving sustainable communities. Civil Engineers have been actively contributing to building sustainable communities. The use of industrial co-generated products such as fly ash, slag and other supplementary cementing materials, as a partial replacement of Portland cement in concrete, is a sustainable solution. It reduces the consumption of Portland cement—which generates carbon dioxide during its manufacturing. Recycling of demolished concrete as aggregate in new concrete or granular base in roads is another example of sustainable solutions. Pervious pavement is also a sustainable idea that helps recharge ground water reservoirs and reduces pavement surface temperature in urban areas. Extending the service life of our structures and reducing the frequency of maintenance and rehabilitation are other ways by which we—Civil Engineers—contribute to building sustainable communities. Our role as Civil Engineers is not limited to finding new sustainable ideas but to work on these ideas and make them feasible from the constructability, cost, and durability standpoints. This is where Civil Engineers from different sectors—governmental agencies, research institutions, contractors, consultants, and materials producers—form teams to turn an idea into reality. New generations of Civil Engineers need to be prepared to face the challenges associated with building sustainable communities. The concept of sustainability is indeed part of many civil engineering courses offered at Canadian universities. This enables engineering students to see sustainability as a holistic approach that applies to different areas of civil engineering. The knowledge and enthusiasm of young engineering graduates coupled with the expertise of experienced engineers can move our communities to a sustainable future.

The theme of this issue is “Sustainable Materials for Green buildings”. The issue includes three articles that shed the light on three sustainable civil engineering initiatives. The first article covers the Ministry of Transportation Ontario (MTO) experience with pervious concrete pavements. The second article covers a sustainable rehabilitation method using ultra-high performance concrete and glass fibre reinforced polymer bars. The third article presents a research that aims at developing standards to enable the use of alternative aggregate sources, including reclaimed concrete materials, to produce unshrinkable fill. ■

La durabilité et notre mission en tant qu'ingénieurs civils

Notre mission en tant qu'ingénieurs civils a toujours été de répondre aux besoins de notre société. À l'heure actuelle, l'un des besoins les plus pressants est la construction d'infrastructures durables. En fait, le concept de durabilité n'est pas limité aux structures, le vrai besoin est de bâtir des communautés durables. La conservation de l'énergie et la réutilisation et le recyclage des ressources non renouvelables ainsi que la réduction des émissions de gaz carbonique sont des mesures de base pour la réalisation de communautés durables. L'utilisation de produits industriels co-générés tels que les escarbilles, les scories et autres matériaux additionnels de cimentation pour le remplacement partiel du ciment Portland dans le béton est une solution durable car elle réduit la consommation de ciment Portland dont la production génère du gaz carbonique. Le recyclage du béton démoli en agrégats utilisés dans la base en béton ou granulaire des routes est un autre exemple de solution durable. Le trottoir perméable est aussi une idée durable qui aiderait à régénérer la nappe phréatique et à réduire la température de surface des trottoirs dans les zones urbaines. Prolonger la vie utile de nos structures et réduire la fréquence de leur entretien et de leur restauration sont une autre manière par laquelle—en tant qu'ingénieurs civils—nous contribuons à la construction de communautés durables. Notre rôle n'est pas limité à trouver de nouvelles idées durables. Il consiste aussi à exploiter ces idées et à les mettre en pratique des points de vue de la réalisation, du coût et de la durabilité. C'est dans ce sens que les ingénieurs civils de divers secteurs—agences gouvernementales, institutions de recherche, les entrepreneurs, les consultants et les producteurs de matériaux—peuvent former des équipes dans le but de transformer une idée en une réalité. Les nouvelles générations d'ingénieurs civils doivent être préparées pour faire face aux défis que pose la construction de communautés durables. Le concept de durabilité fait bien partie de plusieurs programmes d'enseignement en génie civil offerts par les universités canadiennes. Cela permet aux étudiants en génie civil d'appréhender la durabilité comme une approche holistique s'appliquant à divers domaines du génie civil. Le savoir et l'enthousiasme des jeunes diplômés associés à l'expertise des ingénieurs expérimentés peuvent mener nos communautés vers un futur durable.

Ce numéro a pour thème « Des matériaux durables pour des bâtiments verts ». Il comporte trois articles qui présentent trois initiatives durables. Le premier article décrit l'expérience menée par le Ministère des transports de l'Ontario (MTO) dans le domaine des trottoirs perméables. Le second article décrit une méthode de rénovation durable qui utilise du béton de très haute performance et des barres en polymère renforcé de fibre de verre. Le troisième article présente une recherche dont le but est de développer des normes permettant l'utilisation de sources d'agrégats alternatifs, y compris des matériaux en béton récupérés, pour la production de remblai à base de ciment. ■

RANDY PICKLE P.ENG., FCSCE – PRESIDENT@CSCE.CA

In Canada, there appears to be two ways in which the state of the country's infrastructure becomes the topic of the day for discussion by all levels of government: infrastructure failure or economic downturn.

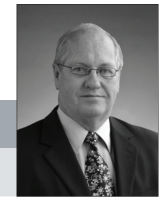
The Canadian economy experienced what has become a cyclical downturn, of varying degrees, in each of the last four decades. The government of the day, in Ottawa, has used theses slumps to propose funding schemes for infrastructure improvements as an economic driver.

These were not the first opportunities that senior governments have taken to improve economic conditions by developing stimulus programmes. In the 1930's there were infrastructure projects created for the purpose of getting Canadians employment following the Great Depression. In 1938 the Thousand Islands Bridge, spanning the Canadian and American shipping channels in the St. Lawrence River, was opened between Gananoque, Ontario and Alexandria, New York. This had been conceived as a joint public works project between Prime Minister MacKenzie King and President Franklin Roosevelt to turn the economy around. The project employed hundreds of workers on the Canadian and American spans over an 18 month period.

In the 1970's and 1980's, the governments of the day appeared content to ride out the economic slowdowns at the expense of the civil infrastructure. In Canada, the oil boom in Alberta softened the impacts in other parts of the country. There was an exporting of technical knowledge and skills, particularly from Ontario, to plan, design and construct the new infrastructure required to support the growth of the oil industry as well as the growth in the population throughout Alberta. A different mindset emerged from our governments to counter the next weak economic period in the 1990's. In 1992, the federal government announces a plan to invest in the aging and deteriorating civil infrastructure of our municipalities. For the most part, it is a first come—first served plan to fund improvements to the civil infrastructure. With urgency to submit applications for funding, municipal agencies utilize their 5 year capital improvement plans to find project candidates. The programme was beneficial in reducing the backlog of infrastructure needs, however, there were side effects. As there was no advancing planning opportunities for project selection, the programme only drew from immediate needs so when the money had been distributed and the projects built, there was a void in infrastructure renewal as municipalities backfilled their capital improvement plans.

By the early 2000, a new federal department had been created, Infrastructure Canada, initially within the Transport Canada ministry. The mandate of Infrastructure Canada is provide effective funding to deal with the nation's civil infrastructure apart from the railroads, airports or Trans Canada Highway. In 2004, the Building Canada plan was implemented. It is a 7-year $33 Billion plan, with matching funding from the provinces and territories and municipalities with expectations to create jobs and provide long term benefits. Eight programmes focused on improvement, renewal and rehabilitation with consideration of the social, environmental and economic impacts of a project. These programmes are in the process of wrapping up and as with previous programmes follow up programming was not conceived when the application period ended.

Recently, Federal Transportation Minister Denis Lebel announced a new process to develop a new long-term plan for civil infrastructure. Through the process, Infrastructure Canada will work with infrastructure stakeholders such as the provinces, territories, Federation of Canadian Municipalities and other interest groups such as the CSCE. It will be a three phase process over the next year. Phase I will focus on the analysis of the past infrastructure investment programmes where post-programme feedback was limited to simply the money being spent. Phase II will identify infrastructure priorities relevant to the economy, environment, community strengthening, financing and asset planning and sustainability. The final phase will develop directions for the civil infrastructure in Canada, taking into consideration lessons learned from the past, for the next long-term infrastructure plan. CSCE will be involved beginning with Phase I as we work on preparing one of eleven theme papers identified by Infrastructure Canada as input to this phase. ■



Au Canada, il semble que l'état des infrastructures devient le sujet du jour dans tous les paliers du gouvernement lors de deux événements : défaillance des infrastructures et ralentissement économique.

L'économie canadienne a vécu ce qui est devenu un ralentissement cyclique à des niveaux divers durant chacune des quatre dernières décennies. Les gouvernements successifs d'Ottawa ont utilisé ces périodes de récession pour proposer des plans de financement afin d'améliorer l'état des infrastructures comme moteur économique.

Ces programmes n'étaient pas les premières mesures que les gouvernements ont prises afin d'améliorer les conditions économiques en développant des programmes de stimulation économique. Dans les années 1930, des projets d'infrastructure furent mis sur pied dans le but de créer de l'emploi après la Grande dépression. En 1938, le Pont des mille iles (Thousand Islands Bridge), qui enjambe les voies maritimes canadiennes et américaines du St-Laurent, fut ouvert entre Gananoque en Ontario et Alexandria à New York. Cette réalisation fut conçue comme un projet de travaux publics commun par le premier ministre MacKenzie King et le président Franklin Roosevelt afin de redresser l'économie. Le projet a employé des centaines d'ouvriers des côtés canadien et américain sur une période de 18 mois.

Dans les années 1970 et 1980, les gouvernements semblaient se contenter de surmonter les ralentissements économiques aux dépends des infrastructures civiles. Au Canada, le boom pétrolier en Alberta a atténué les impacts dans d'autres régions du pays. Des connaissances techniques et des compétences furent exportées, plus particulièrement de l'Ontario, pour la planification, la conception et la construction des nouvelles infrastructures requises pour accompagner la croissance de l'industrie pétrolière ainsi que l'accroissement de la population en Alberta. Nos gouvernements ont fait preuve d'un état d'esprit différent pour faire face à la période de difficultés économiques des années 1990. En 1992, le gouvernement fédéral a annoncé un plan d'investissement dans les infrastructures civiles municipales vétustes et en voie de détérioration. Dans la plupart des cas, il s'agissait d'un plan « premier arrivé, premier servi » pour financer l'amélioration de l'état des infrastructures civiles. L'urgence de soumettre des demandes de financement a amené les agences municipales à utiliser leurs plans d'investissement élaborés sur une période de cinq ans pour identifier des projets à soumettre. Le programme a permis de réduire le retard accumulé dans les besoins en infrastructures, mais il a produit des effets secondaires. Ainsi, il n'a couvert que les besoins immédiats en raison d'un manque d'occasions favorables à une planification pour la sélection des projets. Aussi, lorsque les fonds furent alloués et les projets finalisés, il s'en est suivi un vide dans le renouvellement des infrastructures, car les municipalités ont relégué leurs programmes de renouvellement.

Au début de l'année 2000, un nouveau département fédéral, Infrastructure Canada, fut créé au sein du ministère des Transports. Le mandat d'Infrastructure Canada est de fournir des financements pour les infrastructures civiles nationales autres que les voies ferrées, les aéroports ou la route Transcanadienne. En 2004, le programme Chantiers Canada de 33 milliards $ s'échelonnant sur sept ans que les provinces et territoires et municipalités devaient égaler fut mis en place pour créer des emplois et engendrer des bienfaits à long terme. Huit programmes avaient pour objectif l'amélioration, le renouvellement et la rénovation tout en prenant en considération l'impact social, environnemental et économique du projet. Ces programmes sont en voie d'achèvement et, comme pour les programmes précédents, sans suivi.

Récemment, le ministre fédéral des Transports, monsieur Denis Lebel, a annoncé un nouveau processus d'élaboration d'un nouveau plan d'infrastructures civiles à long terme. À travers ce processus, Infrastructure Canada travaillera avec les intervenants en infrastructures tels que les provinces, les territoires, la Fédération des municipalités canadiennes et autres groupes d'intérêt tels que la SCGC. Il sera mis en place en trois phases durant l'année prochaine. La Phase I mettra l'accent sur une analyse des programmes d'investissement passés dont les comptes rendus ne portaient que sur les sommes dépensées. La Phase II identifiera les priorités en infrastructures qui sont pertinentes à l'économie, l'environnement, le renforcement des communautés, le financement et la planification des actifs, et la durabilité. La phase finale développera les orientations futures des infrastructures civiles au Canada en tenant compte des leçons tirées du passé pour le prochain plan d'infrastructure à long terme. La SCGC prendra part au processus notamment par la préparation de l'une des onze communications thématiques requises dans la Phase I. ■

David Rhead MBA, P.Eng.
Materials Engineering and Research Office, Ministry of Transportation, Toronto, Ontario

Sabrina Li
Materials Engineering and Research Office, Ministry of Transportation, Toronto, Ontario

Pervious Concrete Pavements: MTO's Commitment to Building Sustainable Infrastructure

INTRODUCTION

As part of the Ministry of Transportation Ontario (MTO) drive to pursue innovation and have the "greenest" roads in North America, MTO is actively pursuing use of pervious concrete pavement. The Ministry has completed two pervious concrete commuter parking lots and is currently working on a third. The first project was constructed in 2007 at the Guelph Line interchange on Highway 401, near the town of Milton, Ontario. The second project was a GO Transit commuter parking lot, shown in Figure 1, at the Williams Parkway interchange on Highway 410. A third commuter parking lot is currently being built in partnership with Simcoe County, along Highway 26 northwest of Barrie, Ontario.

AN EMERGING GREEN TECHNOLOGY

Pervious concrete pavements are an innovative concrete technology intended to reduce ecological footprint and benefit the growing urban environment. They create efficient pavement surfaces useful for many low-traffic applications including parking lots and walkways, and are more environmentally friendly than conventional impermeable surfaces.

Pervious concrete is a low slump, open graded mix composed of Portland cement, mainly coarse aggregate with little or no

FIGURE 1: Highway 410 and Williams Parkway, Brampton—GO Transit commuter parking.

fines, admixtures and water. The high void content (15% to 35%) and the presence of inter-connected pores result in a free draining pavement layer that allows water to drain directly into the subgrade, recharging the groundwater, and providing an opportunity to eliminate or reduce stormwater management devices such as ponds and swales.

In the US, pervious concrete is a "best management practice" (BMP) that meets the Environmental Protection Agency (EPA) requirements for stormwater runoff, and is Energy and Environmental Design (LEED) certified. A pervious concrete pavement can provide a number of environmental benefits:

- Elimination or reduction of surface runoff, minimizing the risk of flooding and the presence of a potential drowning hazard.
- Elimination of mosquito-breeding habitat associated with standing water in ditches, helping to control the spread of the West Nile virus.
- The open, interconnected voids of pervious pavement reduce "heat island" effect and associated heating of stormwater. Conventional paving materials can reach summertime temperatures of 50°C to 65°C, transferring excess heat to the air above them and heating stormwater as it runs across pavements. Pervious pavement allows water to enter the ecosystem without warming, minimizing impact on cold-water streams, rivers and fish habitat.
- Enhances vegetation growth by allowing a greater amount of water and air to pass through the pavement and into the ground.

The environmental benefits above make pervious concrete pavements another tool that can help us build more sustainable infrastructure for the benefit of future generations.

DESIGNING HIGHWAY 410 AND WILLIAMS PARKWAY GO TRANSIT COMMUTER LOT

The pavement design included both hydrological and structural components. As this was one of the first pervious pavement designs by MTO, the design incorporated conservative assumptions regarding material properties and time horizons.

The hydrological design followed the guidelines of the Pervious Concrete Hydrological Design Software distributed by the Portland Cement Association. A design consideration was to ensure that the granular base provided adequate drainage and water storage to prevent undrained water freezing in the pervious concrete layer. The structural design followed the guidelines of the StreetPave software distributed by the American Concrete Paving Association. Select Subgrade Material, which is essentially a sandy fill material, was specified where imported fill was required. The final pervious concrete design consisted of: 190 mm of pervious concrete, 200 mm of open granular base, overlying 600 mm of select subgrade material. The overall design thickness was compatible with the original hot mix pavement design thickness of 90 mm hot mix over 300 mm granular subbase.

PERVIOUS CONCRETE REQUIREMENTS

The pervious concrete specification contained a number of material requirements. The coarse aggregate was required to have a maximum nominal aggregate size less than or equal to 13.2 mm. The smaller maximum aggregate size was thought to have potential to not only improve surface texture for pedestrians but improve mix stability. The paste was required to be adequately air entrained to provide freeze-thaw resistance. The in-place pervious concrete was required to achieve a minimum average core compressive strength of 15 MPa at 28 days and void content between 15 to 25%, with no surface ravelling upon visual inspection.

Cold weather constraints of the specification precluded placing pervious concrete when the air temperature was at or below 10°C or likely to be below 10°C in the next 96 hours after concrete placement. Successful completion of a 10 metre long trial slab was required to demonstrate the ability to produce, place, finish and cure the specific pervious concrete mix, prior to proceeding with the work. In addition the contractor or sub-contractor was required to have an individual certified by the National Ready Mix Concrete Association (NRMCA) Pervious Concrete Contractor Certification Program responsible for the pervious concrete placement.

CONSTRUCTION

All site construction including landscaping was completed prior to the start of pervious concrete placement to avoid any potential contamination, premature plugging or damage to the pervious concrete. Concrete trucks discharged their loads into a conveyor from the finished asphalt roadway, thus ensuring no disturbance to the Granular O and granular base granular layers. A conveyor placed the concrete in front of a hydraulically actuated rotating tube (roller) screed. Prior to placing the concrete, the subgrade was pre-wetted to prevent moisture loss from the plastic pervious concrete. The roller screed was supported by fixed forms, edges of pervious concrete pavement, or curb and gutter as shown in Figure 2. When edges of previously placed pavement were used for support, a protective flashing was placed on the edges to reduce the risk of the spinning roller screed damaging the edge.

POST CONSTRUCTION

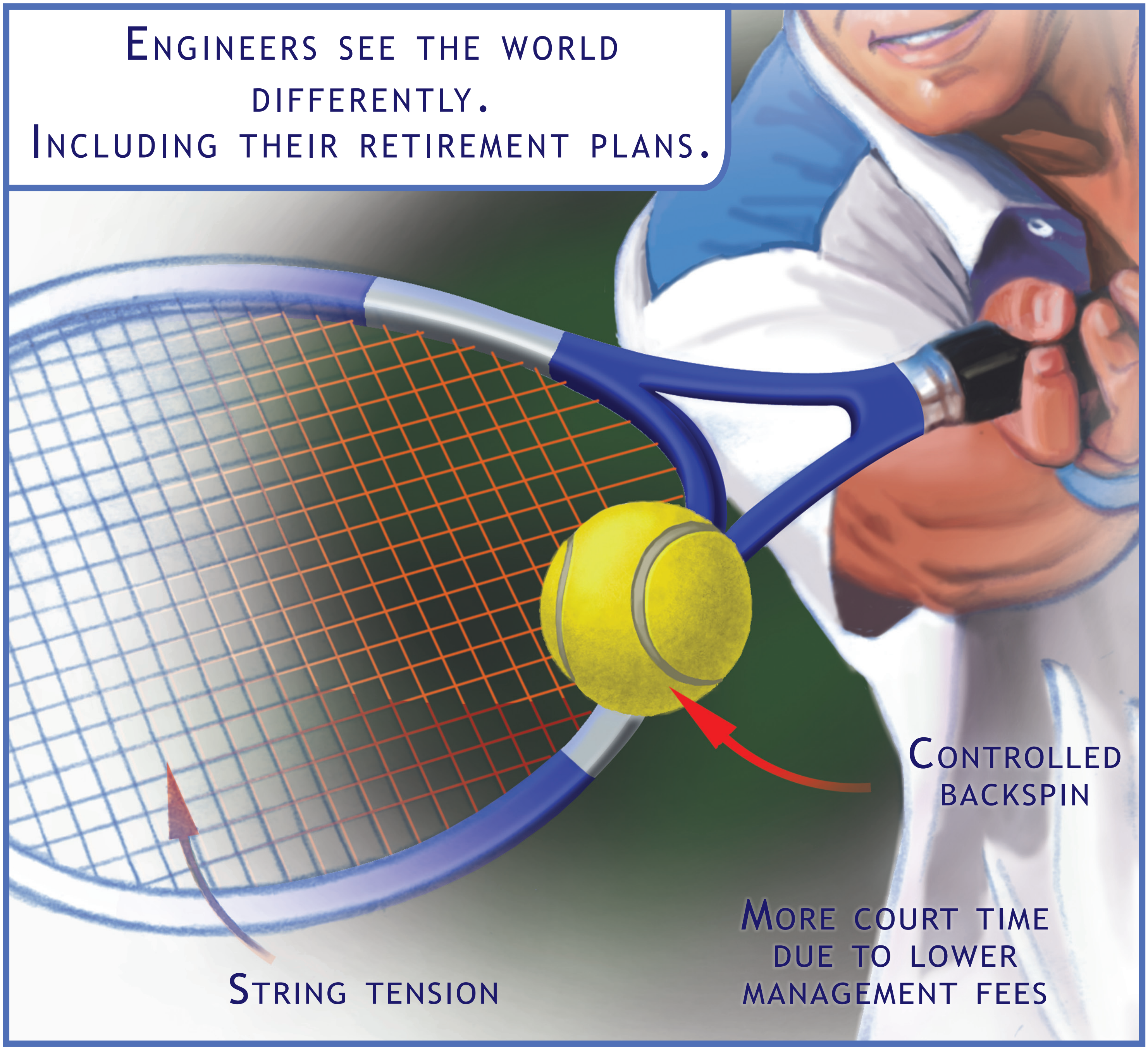
Because the pervious concrete was the last construction item to be installed the finished surface was pristine, with no damage from construction equipment or contamination by construction materials or landscaping.

Pervious concrete pavements are typically designed only for light vehicles. To ensure that heavy vehicles do not gain access to the pervious pavement, a height restriction barrier was installed, based on a post-construction recommendation.

A warranty inspection will be conducted prior to the first winter of exposure and again one year after contract completion, or after six months of service, whichever is the latest. Final acceptance for the pervious concrete pavement be based on this visual inspection for surface irregularities and ravelling.

INNOVATION INVESTIGATION AND MONITORING

MTO, in joint efforts with the University of Waterloo and University of Guelph,



At Great-West Life, we know your high standards extend well beyond your engineering career. Our group retirement plan offers an impressive array of investment options combined with lower-than-market management fees.

Find out more about the only retirement plan officially sponsored by Engineers Canada. Call 1-800-724-3402 or visit www.brainshark.com/grs/mygroupadvantage. You can also scan this code with a QR code reader-enabled mobile phone to easily access more information.

Sponsored by

engineerscanada

THE
Great-West Life
ASSURANCE COMPANY

FIGURE 2: Hydraulic roller screed running along pervious concrete and curb & gutter.

are actively monitoring the performance of several pervious pavement parking lots. Sensors have been installed to monitor water temperature, identify major contaminants and compare rainfall quality to the stormwater quality after filtration through the pavement. The goal of water quality monitoring is to determine the effectiveness of the pervious concrete system in removing contaminants, develop maintenance strategies, and confirm the anticipated environmental benefits. Other areas of research that MTO is pursuing include: void correlation test program in partnership with the Ready Mixed Concrete Association of Ontario, petrographic core examination and falling weight deflectometer testing as a means of assessing long term pavement performance.

CONCLUSION

Pervious concrete pavement technology has been demonstrated to be another tool that is available for building environmentally sustainable low volume pavements in Ontario.

Feedback from the projects described was used to make changes to the ministry's design and construction practices, and contributed to the development of Ontario Provincial Standard Specification OPS 356 "Construction Specification for Pervious Concrete Pavement for Low-Volume Traffic Applications". There has been strong interest from the Ontario municipal sector, conservation authorities and "green" innovators in rapidly incorporating pervious concrete into their designs.

Transfer of technology to other agencies and to industry is being undertaken through publication of peer-reviewed papers and presentations; MTO submitted one of five abstracts for the 2007 Transportation Association of Canada Environmental Achievement Award. The work was presented in August 2008 at the 9th International Conference on Concrete Pavements in San Francisco and a subsequent paper is being submitted to the upcoming 10th International Conference on Concrete Pavements in Quebec City in 2012.

MTO strongly supports creation of sustainable infrastructure, and pervious concrete pavements are another tool for achieving that goal. Pervious concrete pavements can lessen the environmental impact of our built environment and are a promising new green technology. MTO is committed to being a leader in environmentally sustainable infrastructure and will continue to build on the lessons learned from these projects.

For further information please contact: David Rhead, P.Eng. MBA, Senior Concrete Engineer, Ontario Ministry of Transportation, Building C, Room 235, 1201 Wilson Avenue, Downsview, Ontario, M3M 1J8, email: David.Rhead@Ontario.ca

K.M.A. Hossain PhD, P.Eng.
Associate Professor, Department of Civil Engineering, Ryerson University, Canada
C. Mak MASc
EIT, SteenHof Building Services Group, Ontario, Canada
D. Ametrano MASc
Engineer, Thurber Engineering Ltd., Ontario, Canada

GFRP Reinforced UHPC Composites for Sustainable Bridge Construction

INTRODUCTION

Rehabilitation of bridge structures damaged by continuous wear as well as time-dependent and environmental effects is a major concern for a large number of reinforced concrete and prestressed concrete bridge structures. Every year in North America, billions of dollars are spent to repair and maintain bridges. As bridge structures ages, cost of repairs and maintenance magnifies. Conventional structural concrete with steel reinforcing bars can significantly deteriorate with time requiring regular and often costly maintenance. The construction of bridge structures with ultra-high performance concrete (UHPC) and glass fibre reinforced polymer (GFRP) bars can solve premature deterioration due to corrosion of reinforcement, increase the service life and lead to sustainable bridge construction.

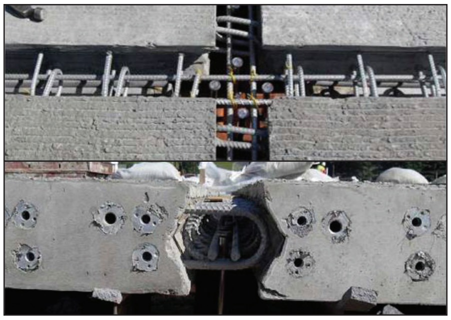


FIGURE 1: Typical bridge joints with steel rebars.

The increased traffic demand pushes for faster overhaul and repair of bridges.

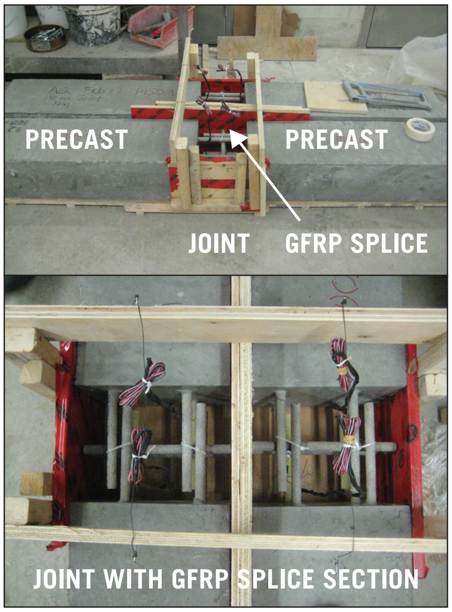


FIGURE 2: Precast slab-beam showing spliced construction joint.

Engineers require prefabrication to minimize traffic interruptions as well as construction costs. One innovative and efficient way to accelerate bridge construction process is to use prefabricated sections joined together by UHPC construction joint made with spliced GFRP bars. Until recently, bridge joint has been mainly constructed with steel bars. High performance bridge joints with GFRP and UHPC can combine superior mechanical and durability properties of both materials.

Ultra-high performance concrete offers advantages such as ability to be virtually self placing, speed of construction, and improved aesthetics as well as superior durability and superior abrasion/impact resistance—which translate to reduced maintenance of bridge structure (Reda et al. 1998; Sahmaran et al. 2009). In addition, use of GFRP reinforced UHPC can reduce the spliced length and hence, reduce the width of the construction joint. "Durable reduced width construction joint" means less concrete needed to be cast on site, less construction time, better quality control and lower cost (Hossain et al. 2011).

The use of GFRP reinforced UHPC in bridge construction is an emerging technology. Little is known about the behavior of GFRP spliced members using ultra-high performance concrete, since very few studies have been conducted. Bond between GFRP and ultra-high performance concrete is still not fully understood. The codes governing the use of GFRP such as the Canadian Highway Bridge Design Code (CHBDC 2006) do not provide provisions for UHPC. The full understanding of the bond characteristics of GFRP bars in UHPC is important for this new technology to be adopted in bridge structures.

RESEARCH PROGRAM

An extensive investigation has been conducted to study the bond strength and development length of GFRP bars in ultra-high performance concrete (Hossain et al. 2011, Mak, 2011; Ametrano, 2011). As a part of the study, slab-beam (representative of actual bridge deck) specimens with GFRP bars as flexural reinforcements having variable splice lengths were tested under four point loading conditions. The spliced region at the centre of the slab-beam specimens simulated a typical construction joint in a bridge deck.

Slab-beam specimens were classified as full cast and precast. Precast slab-beams were constructed using two end precast sections made of a high performance concrete (HPC) with an in-filled GFRP spliced joint section of UHPC at the middle (Figure 2). Such precast slab-beams with a splice joint simulated actual sequence of bridge deck field casting conditions and also illustrated the compatibility of UHPC mixtures in joint construction. Full cast beams having three GFRP splice lengths were made of entirely with UHPC (Figure 3). The splice segment of both precast and full cast slab-beams was located within the pure bending region. HPC and UHPC had developed a compressive strength of 70 MPa and 150 MPa, respectively.

All slab-beams had dimensions of 2000 mm (length) × 200 mm (depth) × 270 mm (width), thus providing enough room for two GFRP bars to be placed in the longitudinal direction. Longitudinal and transverse reinforcements were designed as per CHBDC. 15.9 mm GFRP bars were used as both longitudinal and transverse reinforcements in the specimens (Figure 3). For full cast beams, calculations as per design had shown that the specimens were prone to shear failure. So to induce bond mode of failure, mild steel shear reinforcements (Figure 3) were provided within the shear span region of each of the full cast beams in accordance with the Code provisions.

FIGURE 3: Full cast slab-beam reinforcement details showing spliced region.

TESTING AND OBSERVATIONS

All slab-beams simulating a bridge deck construction joint in the middle were tested under four point loading until failure (Figure 4). These tests provided information on load-deflection response, reinforcing bar strain, crack propagations and failure modes. All full cast slab-beams failed in the tension region by GFRP bar pullout. Judging from the experimental bar strains and the theoretical bar strains obtained from calculation, none had reached the ultimate strength of GFRP bar. The point of failure or critical section occurred within the vicinity of the end of the splice indicating the pullout of GFRP bars (Figure 4).

The precast slab-beams failed in shear with the formation of a large diagonal crack from near the support to the loading point (Figure 5). This shear failure mode was anticipated since calculations showed that the bond capacity of the GFRP splice in UHPC outweighed the shear capacity of plain concrete.

BOND STRENGTH AND SPLICE LENGTH

Figure 6 shows the relationship between bond strength and splice length of GFRP bars obtained from slab-beam tests. Generally bond strength decreases with

FIGURE 4: Test set-up showing typical failure of full cast slab-beam specimens.

the increase of splice length. Overall, a minimum bond strength of 10 MPa was achieved at splice length of up to 300 mm in slab-beam tests. A comparison of the GFRP bar force in the splice region with the splice length is also made using the same tests results (Figure 6). GFRP bar force increases with the increase of splice length but at a lower rate compared with that of bond strength. A bar force of 150 kN is equal to the ultimate capacity of a standard modulus 15.9 GFRP bar. It can be said that a 150 mm standard modulus GFRP splice in UHPC is sufficient to meet the ultimate moment capacity of a non-spliced GFRP slab since bar rupture can be obtained.

CONCLUSIONS

Based on the results obtained from this research, it is concluded that a splice length of between 150 and 225 mm can provide sufficient strength to generate ultimate tensile strength of a standard modulus GFRP bars embedded in UHPC slabs. It is feasible to construct a bridge construction joint with reduced width (spliced length between 150 mm and 225 mm) using standard modulus GFRP bar and UHPC. Superior mechanical and durability properties of both materials can lead to sustainable bridge construction with enhanced service life and economy. However, more investigations with different types of UHPC and fiber reinforced polymer (FRP) bar are needed to fully optimize such composite system for bridge applications.

FIGURE 5: Typical shear failure of precast slab-beam specimens

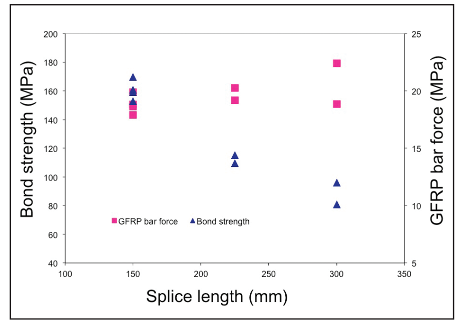


FIGURE 6: Relation between bond strength and splice length of GFRP bars.

REFERENCES

Ametrano, D. (2011). Development length of GFRP bars in ultra high strength concrete, MASc Thesis, Dept. of Civil Engineering, Ryerson University, January.

CHBDC (2006). CAN/CSA S6-06: Canadian highway bridge design code. Canadian Standards Association, Rexdale, ON.

Hossain, K.M.A., Ametrano, D., Mak, C. and Lachemi, M. (2011). Bond strength and development length of GFRP bars in ultra-high performance concrete. Report submitted to MTO Highway Infrastructure Innovation Funding Program (HIIFP), Ministry of Transportation Ontario, pp. 89, May.

Mak, C. (2011). Experimental and theoretical investigation of glass fibre reinforced polymer tension lap splices in ultrahigh performance concrete. MASc Engineering Thesis, Ryerson University, September.

Reda, M., Shrive, N. and Gilliot, J. (1998). Microstructural investigation of innovative UHPC, Cement and Concrete Research, 29(3) 323–329.

Sahmaran, M., Lachemi, M., Hossain, K.M.A., Ranade, R. and Li, V.C. (2009). Influence of aggregate type and size on the ductility and mechanical properties of Engineered Cementitious Composites, ACI Materials Journal, 106(3) 308–316.

The Search for Alternative Aggregate Sources for Unshrinkable Fill: A Step towards Construction Sustainability

Maryam Kolahdoozan

Department of Civil Engineering, Ryerson University, Toronto, Ontario

Mohamed Lachemi Ph.D., P.Eng.

Department of Civil Engineering, Ryerson University, Toronto, Ontario

Medhat Shehata Ph.D., P.Eng.

Department of Civil Engineering, Ryerson University, Toronto, Ontario

Hannah Schell P.Eng.

Materials Engineering and Research Office, Ministry of Transportation, Toronto, Ontario

Stephen Senior P.Eng.

Materials Engineering and Research Office, Ministry of Transportation, Toronto, Ontario

Carole Anne MacDonald

Materials Engineering and Research Office, Ministry of Transportation, Toronto, Ontario

Unshrinkable fill (U-Fill) is a construction material that consolidates under its own weight. Its primary purpose is to act as a removable, non-shrink granular backfill for utility trenches and structures. Technically, U-Fill is a "concrete" product that has a low compressive strength in order to help ease future excavation if needed. It is produced using standard concrete production equipment and is governed in Ontario by Ontario Provincial Standard Specification (OPSS) 1359, which specifies a minimum slump of 150 mm and maximum 28 day compressive strength of 0.70 MPa.

At the present time, aggregates specified for use in the production of U-Fill must meet the high quality requirements for coarse and fine concrete aggregate (OPSS 1002), which may not be necessary in U-Fill applications. The potential exists to specify a more suitable aggregate material that would help conserve valuable, high quality resources, thus contributing to more sustainable road construction. Under the Ministry of Transportation's Highway Infrastructure Innovation Funding Programme for Ontario universities, a research project was initiated at Ryerson University, with the goal of finding alternative sources of aggregates that can be used to produce U-Fill without compromising the performance of the final product.

The Ryerson University research program now underway is investigating the potential of two alternative materials for U-Fill aggregate: (1) reclaimed concrete material (RCM) (Figure 1-a), and (b) quarried granular material (Figure 1-b). Both materials have gradations and physical properties that would meet the requirements of granular base in Ontario (OPSS 1010) but would not meet current concrete aggregate specifications (OPSS 1002). The experimental program will also include a study on the chemical and other properties of suitable aggregate to help develop better guidelines for the selection and acceptance of alternative aggregates for use in U-Fill.

Various properties of the developed U-Fill are being tested including resistance to segregation, hardening time, strength and durability. For coarser graded material, the use of a small percentage of natural sand is essential to optimize gradation and produce workable mixtures. Figure 2 shows the gradations of the alternative aggregates under investigation.

U-FILL USING RECLAIMED CONCRETE MATERIAL (RCM)

The RCM used in this study is comprised mainly of returned-to-plant concrete mixed with about 25% municipal waste concrete. Returned-to-plant concrete is produced from rejected concrete loads that are returned to ready mix plants. Municipal reclaimed concrete is produced from demolished concrete pavements, sidewalks, curbs and other municipal structures. Municipal waste concrete could be mixed with some reclaimed asphalt (RAP) or other non-concrete particles, and could have appreciable amount of chlorides or other ions depending on the type of exposure of the original concrete elements. The returned-to-plant concrete and municipal waste concrete have been further processed to meet the gradation requirements of granular base.

Results show that RCM used in this study can be used to produce U-Fill with acceptable fresh and hardened properties. The as-processed or as-received combined gradations (coarse and fine graded RCM), were adequate to produce mixtures with the

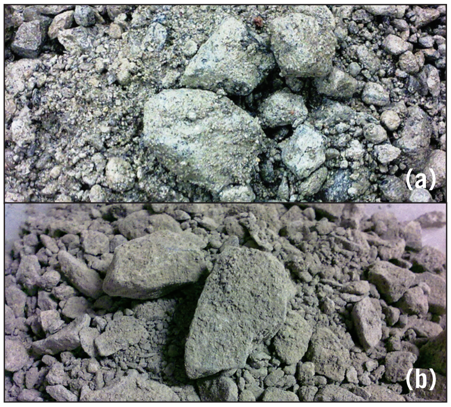


FIGURE 1: Reclaimed concrete material (a); quarried granular material (b).

required flowability and minimum segregation. Initial trials were carried out using 50 kg/m^3 of Portland cement at different water contents. Only mixes with a slump of over 150 mm were considered and tested for hardening time and compressive strength. In all mixtures, the required workability was achieved by adjusting the amount of mixing water. Naturally, the results showed an increase in compressive strength with a decrease in water content. When 210 kg/m^3 water was used, the 28 day compressive strength was 0.873 MPa, and it increased to 1.134 MPa when 165 kg/m^3 water was used. Compressive strengths of this magnitude are generally too high for conventional U-Fill. However, these values could be suitable for applications that involve structural fills.

To reduce the strength, lower cement content was used: 25 kg/m^3. This amount is in line with OPSS 1359. An optimized mix was developed using 190 kg/m^3 of water and 1919 kg/m^3 of RCM. A slump of 160 mm was achieved without much segregation and the 7 day and 28 day compressive strengths were 0.110 MPa and 0.290 MPa, respectively. The hardening time was determined using ASTM 6024 and found to be 18 hours. Hardening time is determined using a box with a depth of at least 150 mm filled with freshly mixed unshrinkable fill. A standard semi-spherical ball weighing 14–15 kg is allowed to drop from a standard height of 9 cm at different time after the fill is mixed (Figure 3). The fill is presumed to be hardened when the indentation diameter is 76 mm, or less (Figure 4) and is ready for loading.

It should be noted that the hardening time of in-situ U-Fill is anticipated to be much shorter that the 18 hours determined in the lab. This is because water is expected to drain-out through the surrounding soil, leading to a faster loading time in the field. From the obtained results, it was concluded that RCA can be used to produce typical U-Fill with the required properties.

U-FILL USING QUARRIED GRANULAR MATERIAL

Crushed bedrock aggregates from two sources meeting the MTO gradation

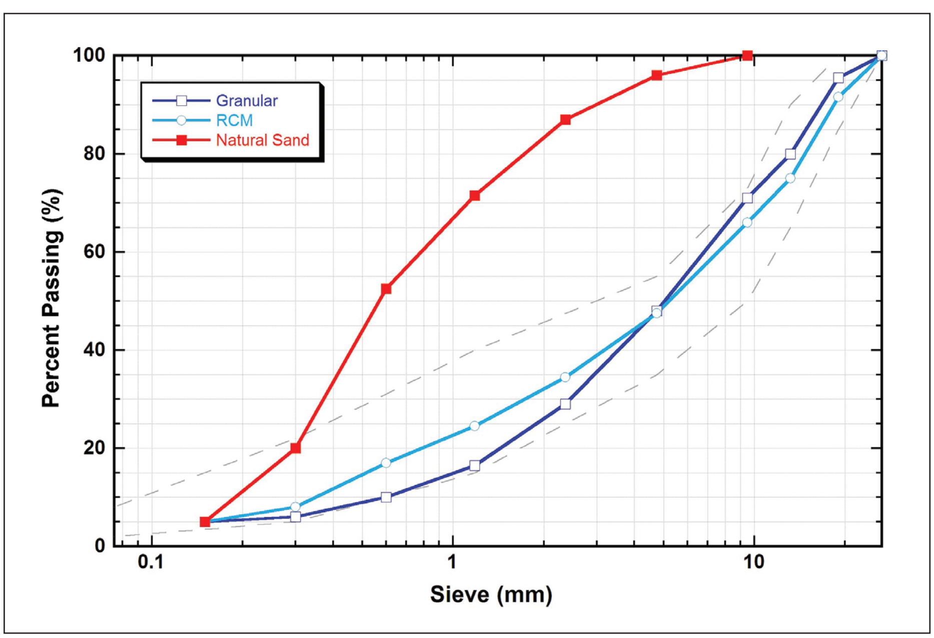


FIGURE 2: Gradation curves for RCM, quarried granular material and blending sand used in this study (Granular A shown for reference).

FIGURE 3: Ball drop apparatus.

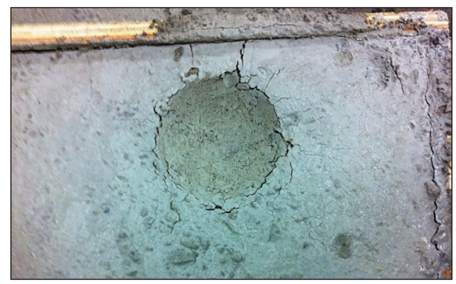


FIGURE 4: Test indentation.

requirements for road base (Granular A, OPSS 1010) were used in this study. However, the physical properties for these materials were marginally less (Granular A requirements include micro-Deval maximum limits of 25% loss for coarse aggregates and 30% loss for fine aggregates). In addition, one of the aggregate samples was characterized by high sulphate content due to the presence of gypsum ($CaSO_4$). Mixes were prepared at different water contents and 25 kg/m^3 cement. The coarse grading of this material produced U-Fill that showed signs of segregation regardless of the amount of water. Figure 5 shows the segregation in samples with varying water contents (210 kg/m^3, 185 kg/m^3, 165 kg/m^3), from left to right respectively.

It was concluded that the lack of fine aggregate, i.e. materials passing 4.75 mm sieve, produced mixtures that were prone to segregation. To enhance the cohesiveness of the mix, various levels of natural sand were included in the mix. Different compositions were tested in order to achieve optimum flowability with minimal use of sand. It was observed that a mixture of 15% sand and 85% granular material produced an acceptable mix with adequate fresh properties, as

FIGURE 5: U-Fill samples produced from crushed granular at variable water contents: 210 kg/m³ (left), 185 kg/m³ (center) and 165 kg/m³ (right).

FIGURE 6: U-Fill samples composed of 15% natural sand and 85% crushed granular material.

shown in Figure 6. The final optimized mix had a cement content of 25 kg/m³, granular content of 1611 kg/m³, natural sand content of 284 kg/m³ and a water content of 185 kg/m³. The slump of this mix was 165 mm with 28 day compressive strength of 0.364 MPa and hardening time of 36 hours.

EFFECTS OF AGGREGATE GRADATION

Based on the results, it can be concluded that the use of alternative aggregates to produce U-Fill may require the addition of a small percentage of a blending sand to reduce segregation. While the gradation of the two materials investigated in this study produced different results, a workable U-Fill can be obtained with the addition of blending sand in the case of coarse graded materials. The mix design needs to be adjusted according to the gradation of the aggregate used. It should be noted that since U-Fill contains very limited amount of Portland cement, it is likely that adjusting the aggregate gradation for the purpose of preventing segregation will be by way of adding sand, since the level of fines (i.e. Portland cement) in the mix is low.

OTHER CONSIDERATIONS AND FUTURE WORK

The long-term performance and durability of U-Fill made with alternative aggregate sources is currently under investigation at Ryerson University. In addition, a field trial will take place in 2012 to evaluate the field performance of the U-Fill with alternative aggregates. The performance of these U-Fill mixtures will be compared to a U-Fill mixture with concrete aggregates. The outcomes of the study will be a proposed specification for alternatives aggregates for use in U-Fill. The specification is anticipated establish the limits on acceptable physical properties and chemical compositions of aggregates for use in U-Fill. Considering that unshrinkable fill is used by both MTO and municipalities, there is considerable future potential for the use of alternative/recycled materials in large quantities throughout Ontario. ■

ANTO SUCIC GRADUATE STUDENT, DEPARTMENT OF CIVIL ENGINEERING, RYERSON UNIVERSITY
DOUG SALLOUM BSC, MBA, PMP, EXECUTIVE DIRECTOR / DIRECTEUR EXÉCUTIF

That little extra something in an engineering education…

If "Scientists investigate that which already is; Engineers create that which has never been" (Einstein). As engineers, we constantly need to not only 'think outside the box' but also sometimes to re-invent the 'box' itself. Pursuing these opportunities is precisely what drives us to be the innovators and problem solvers of tomorrow.

From the point of view of a Canadian engineering student, perhaps one of the best opportunities for an innovative learning experience is participation in a national engineering student competition. One of the best of these, the CSCE Troitsky Bridge competition, was held at Concordia University in Montreal on March 2. Another excellent competition, the CSCE Concrete Canoe race this year will be hosted by Université de Moncton, from May 10–13. Both of these events are sanctioned and sponsored by CSCE for the next five years.

The third major national engineering competition is the Great Northern Concrete Toboggan Race (GNCTR). The 38th running of this event was hosted by University of Calgary February 8–12.

All three student competitions demand and instill the very qualities any engineer should possess: leadership, technical know-how, the ability to apply that knowledge to a new task, and an innovative and persistent intellect. Managing the design and creation of a 5-person toboggan, for example, is much like running a small company. Teams must design the shape and superstructure of the toboggan, a functioning steering and braking system, an economically and environmentally effective concrete mix design, and a method of casting precisely designed skis. The toboggan must then be tested in a real life situation—from the top to the bottom of a snow covered hill. This is not an academic exercise.

The spirit and camaraderie of the event is one of the great attractions to participation in a national student competition. By expressing their individual ideas in original and often humorous ways, students create for themselves experiences that they will always remember.

If you have not yet competed in one of these events plan to do so next year. By the way, the GNCTR is seeking an Eastern Canadian university to host the event in 2014. Check out the website: www.gnctr2012.com.

Ryerson University's entry in the GNCTR "Pirates of the Cariboggan" 2009.
Participation de Ryerson University au GNCTR « Pirates du Cariboggan » 2009.

Ce petit plus dans une formation en ingénierie

Si « Les scientifiques investiguent ce qui est déjà, les ingénieurs créent ce qui n'a jamais été » (Einstein). En tant qu'ingénieurs, nous devons constamment non seulement réfléchir de façon non conventionnelle « hors de la boîte » mais aussi parfois réinventer cette « boîte ». Poursuivre ces opportunités est justement ce qui nous pousse à être les innovateurs de demain.

Du point de vue d'un étudiant canadien en ingénierie, l'une des meilleures opportunités pour un apprentissage innovant peut être une participation à un concours national d'ingénierie pour étudiants. L'un des meilleurs de ces concours, le Concours de pont Troitsky de la SCGC, eut lieu à l'université Concordia de Montréal le 2 mars. Un autre excellent concours, la Course de canoës en béton de la SCGC, se déroulera à l'Université de Moncton du 10 au 13 mai 2012. Ces deux événements sont approuvés et commandités pas la SCGC pour les cinq prochaines années.

Le troisième plus grand concours national en ingénierie est la Grande course de toboggans du nord (Great Northern Concrete Toboggan Race, GNCTR). La 38è édition de cet événement aura lieu à l'université de Calgary du 8 au 12 février 2012.

Les trois concours exigent et inculquent les qualités que tout ingénieur doit posséder : leadership, savoir-faire technique, aptitude à mettre ce savoir en pratique dans une nouvelle tâche et un intellect innovant et persistant. Ainsi, gérer la conception et la création d'un toboggan de cinq personnes ressemble beaucoup à la gestion d'une petite entreprise. Les équipes doivent concevoir la forme et la superstructure du toboggan, un système de direction et de freinage viables, un mélange de béton efficient sur les plans économique et environnemental ainsi qu'une méthode de coulage de skis conçus d'une manière bien précise. Le toboggan doit ensuite être testé dans des conditions réelles, du sommet au bas d'une colline enneigée, le tout n'étant pas un exercice académique.

L'humeur et la camaraderie de l'événement est l'un des grands attraits d'une participation à un concours national pour étudiants. En présentant leurs idées de façons originales et souvent humoristiques, les étudiants se créent des expériences dont ils se souviendront toujours.

Si vous n'avez pas encore participé à l'un de ces événements, projetez de le faire l'année prochaine. À propos, le GNCTR est à la recherche d'une université dans l'est du Canada pour recevoir cet événement en 2014. Visitez www.gnctr2012.com.

MAHMOUD LARDJANE MAHMOUD@CSCE.CA

GUIDE TO BRIDGE HYDRAULICS

April 10–20, 2012
Winnipeg, Ottawa, Toronto, Quebec City, Montreal, St. John's, Moncton

This CSCE-CSA course is based on TAC's Guide to Bridge Hydraulics. It covers planning, design as well as operations and maintenance of bridges relative to their hydraulics. It addresses key topics such as boundary conditions, waterway design, scour protection and channel control as well as hydraulic aspects of construction, inspection and maintenance.

Presenter:
Marcel Chichak, P.Eng. *AECO*, Edmonton, AB

COURSES AT CSCE 2012 ANNUAL CONFERENCE

June 6, 2012
Edmonton

Infrastructure Asset Management

This half-day course introduces the principles of infrastructure management in the practical context of two municipalities: small (Clarence-Rockland, On) and large (Edmonton, AB). The participants will learn about the principles and key steps in the development of an asset management plan. The presenters will also make linkages between asset management and asset accounting (PS 3150) which plays an important role in municipal reporting.

Presenters:
Guy Félio, Ph.D., P.Eng., President, Infrastructure Strategies & Research Inc., Rockland, ON
Konrad Siu, M.Eng, MBA, P.Eng., FCSCE, City of Edmonton

Winter Road Maintenance—Performance Measurement and Evaluation

This half-day course will introduce the fundamentals of performance measurement for highway winter maintenance operations. They include basic concepts, performance measurement framework, alternative performance measures, and data needs, and a new software tool that can be used to automate the performance measurement process.

Presenter:
Liping Fu, Ph.D., Professor and Director of the iTSS Lab, Department of Civil and Environmental Engineering, University of Waterloo

For more details and to register, please visit www.csce.ca.

FORMATIONS PRÉSENTÉES EN ANGLAIS

GUIDE TO BRIDGE HYDRAULICS

10–20 avril 2012
Winnipeg, Ottawa, Toronto, Québec, Montréal, St. John's, Moncton

Basée sur le « Guide to Bridge Hydraulics » de l'ATC, cette formation est co-présentée par la SCGC et CSA. Elle couvre la conception, l'exploitation et la maintenance des ponts en rapport avec leur hydraulique, notamment les aspects hydrauliques de leur construction, inspection et maintenance.

Formateur :
Marcel Chichak, P.Eng., *AECOM*, Edmonton, AB

CONGRÈS ANNUEL DE LA SCGC

6 juin 2012
Edmonton

Gestion des actifs en infrastructures

Cette formation d'une demi-journée couvre les principes de gestion des infrastructures dans le contexte pratique de deux municipalités: une petite (Clarence-Rockland, On) et une grande (Edmonton, AB). Elle présente les principes et les étapes importantes de développement d'un plan degestion des actifs. Les formateurs établiront des liens entre la gestion et la comptabilité des actifs (PS 3150).

Formateurs :
Guy Félio, Ph.D., P.Eng., Président, Infrastructure Strategies & Research Inc., Rockland, ON
Konrad Siu, M.Eng, MBA, P.Eng., FCSCE, Ville d'Edmonton

Maintenance des routes en conditions hivernales—Mesure et évaluation des performances

Cette formation d'une demi-journée présente les éléments essentiels de la mesure de la performance des opérations de maintenance hivernale des autoroutes. Ils comprennent des concepts de base, le cadre de mesure de la performance, des mesures de performance alternatives et les données nécessaires ainsi qu'un nouveau logiciel pouvant automatiser le procédé de mesure de la performance.

Formateur :
Liping Fu, Ph.D., Professeur et directeur du Laboratoire iTSS, Département de génie civil et de l'environnement, University of Waterloo

Pour plus de détails et vous inscrire, veuillez visiter www.csce.ca.

DOUG SALLOUM BSC, MBA, PMP, EXECUTIVE DIRECTOR / DIRECTEUR EXÉCUTIF

The Art of Sustainable Infrastructure

The first CSCE Award for Governmental Leadership in Sustainable Infrastructure will be awarded to some worthy public sector entity during the CSCE Annual Conference in Edmonton, from June 6–9, 2012.

At this point we can't give away any secrets but we can say that National Office received 8 nominations for this Award. These nominations will be judged by a panel under the direction of CSCE's Honours and Fellowships Committee. We expect them to have made a decision by the end of March.

A very interesting parallel process involves a Call for Artists that National Office has also initiated. CSCE is looking for a young Alberta artist to provide an original piece of two-dimensional art. This work of art will be the prize for the winner of the Governmental Leadership Award. The Call for Artists was sent out early January to Alberta art schools, galleries and funding organizations. Artists will submit photographs of their works and CSCE will exhibit the originals of up to 10 finalists at the Annual Conference.

The works of art will be judged by second panel consisting of Ryan Doherty (a curator at Southern Alberta Art Gallery), Kate Puxley (a young Montreal artist) and your Executive Director, Doug Salloum. There will also be an opportunity for members to vote for the Peoples' Choice Award. The winning artist will receive a prize of $4,000 and the Peoples' Choice winner, $1,000.

CSCE is very pleased to be able to support young artists in Alberta. Next year the competition will be for young Quebec artists and the prizes will be awarded at the Montreal Annual Conference. ■

L'art des infrastructures durables

Le premier Prix du Leadership gouvernemental en infrastructures durables sera décerné à une entité du secteur public méritante lors du congrès annuel de la SCGC qui se déroulera à Edmonton du 6 au 9 juin 2012.

Nous ne pouvons pas révéler de secrets à ce stade mais nous pouvons dire que le Bureau national a reçu huit candidatures pour ce prix. Ces candidatures seront jugées par un jury placé sous la direction du Comité des distinctions honorifiques et fellowships. Nous pensons que le jury aura pris sa décision vers la fin mars.

Dans un processus parallèle fort intéressant, le Bureau national a lancé un Appel à des artistes. La SCGC recherche un ou une jeune artiste de l'Alberta pour produire une œuvre d'art originale en deux dimensions. Cette œuvre sera le prix qui sera décerné au vainqueur du Prix du leadership gouvernemental. L'Appel aux artistes fut lancé début janvier à des écoles d'art, des galeries et des organisations de financement. Les artistes soumettront des photographies de leurs œuvres, et la SCGC exposera les originaux de 10 finalistes lors du congrès annuel.

Les œuvres seront jugées par un second jury qui comprend Ryan Doherty (un conservateur de la Southern Alberta Art Gallery), Kate Puxley (une jeune artiste de Montréal) et votre directeur exécutif, Doug Salloum. Les membres auront eux aussi l'opportunité de voter pour le Prix du choix populaire. L'heureux gagnant du Prix du leadership gouvernemental recevra 4 000 $ et celui du Prix du choix populaire 1 000 $.

La SCGC est très heureuse d'apporter son appui à de jeunes artistes de l'Alberta. L'année prochaine, le concours sera ouvert aux jeunes artistes du Québec et les prix seront remis au congrès annuel de Montréal. ■

MAJOR PARTNERS / ASSOCIÉS PRINCIPAUX

PARTNERS / ASSOCIÉS

AFFILIATES / AFFILIÉS

CSCE SECTIONS SCGC

Newfoundland
Contact: Bing Chen, MCSCE
T: 709-864-8958 F: 709-864-4042
E-mail: bchen@mun.ca

Nova Scotia
Contact: To be determined

East New Brunswick and P.E.I. (Moncton)
Contact: Luc DeGrâce
T: 506-856-9601
E-mail: luc.degrace@valron.ca

West New Brunswick
Contact: Andy Small, MCSCE
T: 506-458-1000 F: 506-450-0829
E-mail: andy.small@amec.com

Montréal
Contact: Stéphane Marcouiller, MSCGC
T: 450-967-1260, ext. 3636 F: 450-639-8737
E-mail: stephane.marcouiller@tecsult.com

Sherbrooke
Contact: Eric St-Georges, MCSCE
T: 819-791-5744, ext. 103
F: 819-791-2271

Québec
Contact: Francis Labrecque, AMSCGC
T: 418-623-3373, ext. 192
F: 418-623-3321
Courriel: Francis.Labrecque@cima.ca

Capital Section (Ottawa-Gatineau)
Contact: Gary Holowach, MCSCE
T: 613-739-3255
E-mail: gholowach@morrisonhershfield.com

Toronto
Contact: Cameron Blair
T: 905-803-6357
E-mail: cblair@ellisdon.com

Hamilton/Niagara
Contact: Ben Hunter, MCSCE
T: 905-335-2353 ext. 269 F: 905-335-1414
E-mail: ben.hunter@amec.com

Northwestern Ontario
Contact: Gerry Buckrell, MCSCE
T: 807-623-3449 F: 807-623-5925
E-mail: gbuckrell@enl-tbay.com

Durham/Northumberland
Contact: Brandon Robinson
T: 905-668-4113 ext. 3439
E-mail: brandonrobinsoncsce-dn@live.com

London & District
Contact: Thomas Mara, MCSCE
E-mail: tmara3@uwo.ca

Manitoba
Contact: Dagmar Svecova, MCSCE
T: 204-474-9180 F: 204-474-7513
E-mail: svecovad@cc.umanitoba.ca

South Saskatchewan
Contact: Harold Retzlaff, MCSCE
T: 306-787-5642 F: 306-787-4910
E-mail: harold.retzlaff@gov.sk.ca

Saskatoon
Contact: Mike Hnatiuk, MCSCE
T: 306-477-0655 F: 306-477-1995
E-mail: m.hnatiuk@robb-kullman.com

Calgary
Contact: Dan Dankewich, MCSCE
E-mail: ddanke2@telus.net

Edmonton
Contact: Andrew Neilson
T: 780-917-4669
E-mail: ANeilson@designdialog.ca

Vancouver
Contact: Lacey Hirtle
T: 604-871-6392
E-mail: lacey.hirtle@gmail.com

Vancouver Island
Contact: Kevin Baskin, FCSCE
E-mail: kevin.baskin@gov.bc.ca

CSCE Hong Kong Branch
Contact: Moe M.S. Cheung, FCSCE
T: 852-2358-7152
E-mail: mscheung@ust.hk

TD Insurance
Meloche Monnex

"I got great coverage and preferred rates."

– Rakesh Shreewastav
Satisfied client since 2003

See how good your quote can be.

At TD Insurance Meloche Monnex, we know how important it is to save wherever you can. As a member of the **Canadian Society for Civil Engineering**, you can enjoy preferred group rates on your home and auto insurance and other exclusive privileges, thanks to our partnership with your association. You'll also benefit from great coverage and outstanding service. We believe in making insurance easy to understand so you can choose your coverage with confidence.

Get an online quote at
www.melochemonnex.com/csce
or call 1-866-269-1371
Monday to Friday, 8 a.m. to 8 p.m.
Saturday, 9 a.m. to 4 p.m.

Endorsed by:

engineerscanada
Engineers Canada is the business name of the Canadian Council of Professional Engineers

CSCE CCGC 1887

TD

The TD Insurance Meloche Monnex home and auto insurance program is underwritten by **SECURITY NATIONAL INSURANCE COMPANY.** The program is distributed by Meloche Monnex Insurance and Financial Services Inc. in Quebec and by Meloche Monnex Financial Services Inc. in the rest of Canada.

Due to provincial legislation, our auto insurance program is not offered in British Columbia, Manitoba or Saskatchewan.

*No purchase required. Contest organized jointly with Primmum Insurance Company and open to members, employees and other eligible persons belonging to employer, professional and alumni groups which have an agreement with and are entitled to group rates from the organizers. Contest ends on January 31, 2013. 1 prize to be won. The winner may choose the prize between a Lexus RX 450h with all basic standard features including freight and pre-delivery inspection for a total value of $60,000 or $60,000 in Canadian funds. The winner will be responsible to pay for the sale taxes applicable to the vehicle. Skill-testing question required. Odds of winning depend on number of entries received. Complete contest rules available at www.melochemonnex.com/contest.