Successes and Challenges of Two Experienced Canadian Architectural UHPC Precasters

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Abstract

m3béton and Szolyd Concrete Corp (Szolyd) are two experienced architectural UHPC precasters who share their insights on the challenges and successes of working with UHPC for over 15 years creating art installations, urban furniture and architectural elements pieces. This presentation illustrates what allowed these innovative firms to become experts in the architectural UHPC field. In particular, these precasters have worked to resolve unique design and fabrication challenges that will be demonstrated and highlighted through key projects. Achieving excellent surface aesthetics while using extremely thin sections is often why UHPC is selected for these unique projects. Surface finish, texture and colour are key elements for these precast elements and managing expectations are an integral part of the design. Fabrication of these intricate precast elements is only possible because the precasters have developed specific techniques and a great understanding of UHPC's properties and limits. This presentation will discuss the fundamentals of architectural UHPC and its technical challenges for surface finish, texture and complex shapes. The long-term performance of completed projects will be reviewed. The precasters' insights on the successes and challenges for these projects will also be discussed. Finally, the future of architectural UHPC will be discussed.

Keywords: UHPC, precaster, mold, colour, surface finish, urban furniture, architectural precast.

1. Introduction

m3béton (Montreal, QC) and Szolyd (Victoria, BC) are two unique Canadian UHPC precasters, who were the early adopters of UHPC in North America. Their journey started 15 years ago

before UHPC became popular for bridge rehabilitation and overlays. They both mastered the material, developed techniques and with their clients, they have been able to produce unique pieces which are proof of their ingenuity, drive and dedication.

2. Why Use UHPC?

These two precasters wanted to push the limits by using UHPC's properties to create unique pieces which were not possible to fabricate with traditional concrete. m3béton has a saying: "we create the antiques of the future". Sustainable design and longevity are key reasons to use UHPC. Their goal is to create long lasting pieces that will be shared/viewed/used for many generations to come.

3. What Does It Take To Be Successful?

Both precasters share a passion for the material and over the years learned how to successfully setup a project. In some ways, to work with UHPC, a traditional precaster has to re-learn how to work with a flowable concrete product because many traditional techniques need to be adapted. UHPC is an expensive material, hence budget and design expectations need to align for a successful project. Expectations have to be managed throughout the process.

In many instances, both design and fabrication need to be addressed at the same time. An intricate design can be fabricated but can it be done at an affordable cost while meeting the expectations of the client.

Everyone agrees that UHPC is a natural, mineral product and therefore colour variations can occur. Many clients expect a flawless finish, hence precasters need to leverage all the trick they have to ensure the best outcome possible. For instance, Szolyd uses a temperature and humidity chamber to speed up curing that also helps to provide consistency in colour.

Vibration of the mix prior to casting and/or the vibration of the mold during casting will help reduce voids. Making sure the molds remain full during casting/curing while allowing air to escape from the matrix is a key consideration. Orientation of the mold during curing can also be used to "direct" the air bubbles to the non-visible, underside of a piece.

Materials used for molds will dictate the quality and the number of pulls possible. For positive molds, investing money upfront will save money going forward. A positive mold can cost 5 to 10 times the cost of the production part. Liners are usually used to provide the required finish.

Samples and mockups are critical tools to help the clients understand UHPC benefits and limitations. For architectural pieces, finishes are a key item of discussion. Mock-ups and

selecting the correct sample size will allow the client to have a more realistic understanding of the final product.

4. Typical Precast Elements

Many one off pieces have been cast using UHPC. Samples of these projects can be found on the precasters' websites: m3beton.ca and szolyd.com. One constant is that most UHPC pieces are for outdoors use and take advantage of UHPC's durability characteristics. Both precasters have worked on a number of urban furniture pieces. Some pieces are unique, while other are mass produced applications such as building façade elements, tables, stair treads and benches.

5. Durability / Longevity

UHPC elements have the potential to last over 100 years. However, in practical terms, as a "new" material, UHPC precast elements are less than 20 years old. This relative short period of time is however providing great insight in how UHPC performs over time. Szolyd hears regularly from satisfied customers commenting on the performance of their UHPC elements. Existing pieces have a very similar appearance and look compared to when they were first installed. There hasn't been any structural issues.

6. The Future

Sustainability and durability are key reasons why a UHPC product makes sense for architectural precast elements. The cost of UHPC material is always a point of discussion with any clients. Continued efforts to lower the cost of the UHPC matrix will be an important factor so precasters can continue to grow. Szolyd wants to push the envelope and use the best materials (i.e. UHPC or others) to create long-lasting beautiful elements with an emphases on local production and local materials. This could take the form of a micro factory, located near a construction site. For the future, they see prefabricated wall elements with UHPC cladding as a way to build more efficiently with a focus on sustainability. m3béton is betting on its current successes, over 100 outdoors ping-pong tables installed to date, to pursue quality repetitive urban furniture projects that are well thought off and will provide years and years of use in harsh exterior conditions.

7. Conclusions

The goal of this paper and presentation was to highlight how two Canadian UHPC precasters have navigated the UHPC world for the last 15 years. As noted above, UHPC has its own challenges but the rewards of working with such a unique material keeps these two precasters very optimistic.