

PROJECT PROFILE

PLAEX BUILDING PRODUCTS



PLAEX Building Systems Inc., a company based in New Brunswick, is working towards producing plug-and-play concrete-like building blocks using recycled aggregate and recycled plastic as the binder. UNB Off-site Construction Research Centre partnered with PLAEX in assessing the mechanical properties and durability of their products.

PROJECT BACKGROUND

Normal density concrete is made of aggregates, sand, Portland cement, water and additives which usually results in 20-30 MPa compressive strength. PLAEX products consist of very fine recycled aggregates (sand) and recycled plastic, typically polyethylene, as the binder.

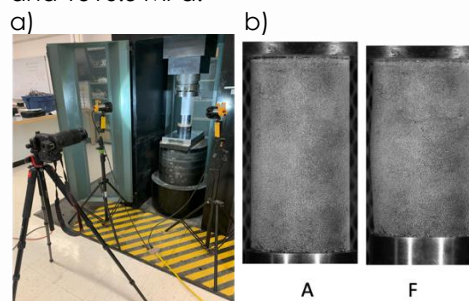
Mechanical tests were conducted to measure and assess the difference in stress-strain behaviour when subjected to tension vs. compression, the modulus of elasticity (E), and the compressive and tensile strengths. To assess the effects of temperature, compressive strength tests were also conducted on samples subjected to varying temperature from +40 to -20 °C.

RESULTS

Compressive and tensile strength tests were conducted according to ASTM C39 and C78 standards, respectively. A 16 Giga-Pixel camera was used to track the deformation of the specimens under load in order to measure strain using Digital Image Correlation technique. The stress-strain graphs in flexural-tensile strength tests showed that the material behaves differently in tension and compression. Therefore, the modulus of elasticity from the compressive strength test was incorporated in the flexural tensile strength test results to calculate the modulus of elasticity in tension.

The compressive strength (σ_c) and E_c were calculated as 19.8 MPa and 2067.6 MPa, respectively. Unlike normal concrete which experiences sudden failure, PLAEX samples experienced a very ductile failure by showing

extensive axial deformation bulging without disintegration showing high energy absorption. The tensile strength (σ_t) and (E) of the specimen were 20 MPa and 1516.5 MPa.



a) Compressive strength test and DIC camera
b) Undeformed (A) vs. failed specimen (F): showing shortened and bulged shape.

Compressive strength test results when subjected to varying temperatures is summarized in the table below. The results show that the strength usually increases when the temperature drops below zero and decreases when the temperature increases to 40 °C.

Temp (°C)	-20	-10	0	10	30	40
σ_c (MPa)	31.0	36.0	26.6	28	13	17

RECOMMENDATIONS

PLAEX products meet the compressive strength of normal concrete (20-30 MPa). However, the material behaves differently in tension and compression and reaches a high tensile strength of ~20 MPa when compared to normal concrete. The material is ductile both in compression and tension, with a modulus of elasticity (2 and 1.5 GPa) which are about 10 times less than normal concrete (20-25 GPa). At around 20 °C, the compressive strength was similar to normal concrete, while the samples had higher strength (~30 MPa) in very cold temperatures (-10 to -20 °C) and lower strength (~15 MPa) in very high temperatures (30-40°C).