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Artificial swimming pond using Biodesign Pools technology[©]

Technical structural report

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1. Scope of the report

This technical document describes the structural aspect of the application of the building materials of ground quartz and resin in the construction of swimming pools, artificial ponds and water holding vessels, made with the use of the technology of Biodesign pools Srl , Padova, Italy.

In particular, the results of the mechanical experimental tests conducted on the material in relation to the application technology, are evaluated with the aim of determining the structural safety.

To this end, it is appropriate to briefly illustrate the construction technology of Biodesign Pools (hereinafter Biodesign). It involves the following steps:

1. execution and modelling of the excavation, with low gradient around the perimeter (within 45 °) and limited depth (within 1.5 m).
2. laying of protective geotextile
3. positioning of EPDM waterproof liner
4. handmade laying of ground quartz and resin

The Biodesign technology allows pools to be built that look similar to natural basins, characterized by gentle gradients of coastline and shallow water . The material Biodesign is conceived with the aim to produce a mechanical barrier, which is completely permeable to water, while offering a high aesthetic value.

2. Analysis of materials

The table below is a brief excerpt of the results obtained with experimental tests conducted on the material ground quartz and resin, with which is realized the inner shell of the swimming pond.

Name	Ultimate load [kN]	Ultimate resistance tensile bending [MPa]	Arrow Centerline [mm]
Mono 1	27.9	5.6	1.59
Mono 2	24.9	5.0	1.43
Mono 3	29.2	5.8	1.23
A + B 1	35.4	7.1	2.02
A + B 2	37.7	7.5	2.61
A + B 3	32.6	6.5	1.19
A + B + rete 1	46.1	9.2	3.16
A + B + rete 2	44.9	9.0	4.39
A + B + rete 3	41.9	8.4	3.88

Table 3: Results of the 3-point bending test

Name	Ultimate load [kN]	Ultimate strength in compression [MPa]
Mono 1	337	15.0
Mono 2	294	13.1
Mono 3	262	11.6
A + B 1	288	12.8
A + B 2	281	12.5
A + B 3	333	14.8

Table 4: Results of compression test

It is noted that the tensile test was performed by broadening the testing joists with the structural net (fibreglass) as used in the stratigraphy of the technology. It is clear that the material thus conceived guarantees:

Mechanical property	MPa
Average tensile strength with flexibility tests	7
Average compression strength	13

3. Static Analysis

The static peculiarity of the Biodesign system consists of the fact that the volume of water inside the swimming 'lake' is directly supported from the ground below through the waterproof EPDM barrier. That is, the composite material being a very porous aggregate, such as to be completely permeable, the water pressure is discharged directly onto the ground. So, the hard shell of quartz and resin plays a support action simply of its own weight and of imposed loads that may be present, such as the weight of the bathers. The latter, however, induce a compressive stress in the composite considerably less than its resistance.

Furthermore, a possible shift of the ground below the base, which in traditional technology of the pools in reinforced concrete can cause an excessive load on the structure, in the case of Biodesign swimming 'lakes', has no effect of increasing such loads.

Similarly, the conformation of the slope of the 'lake', with a slope not exceeding 45°, determines the absence of thrust of the earth towards the inside of the pool, since the same are transmitted through the cohesion and the internal friction of the earth.

In light of the above, it can therefore be considered with utmost certainty that the inner shell of the Biodesign technology, composed of ground quartz and resin is, under normal conditions of use, practically free from constraints associated with structures built from reinforced concrete and therefore has no requirement for structural design and calculations.

4. Conclusion

As explained in this report, the construction specifics of Biodesign swimming 'lakes' is such as to give the final product a high structural safety, due primarily to the details of the construction design, which permits absorption of the internal pressure of the earth and, at the same time, directs the water pressure downwards directly against the earth itself.

The structure is free from stresses due to the pressures of the ground as well as hydrostatic pressure, both along the inclined walls as well as on the base.

The shell made of ground quartz and resin, completely permeable, plays a mainly aesthetic and mechanical barrier for light loads, such as the bather load (to the extent not absorbed by buoyancy).

The shell in question is therefore subject to very limited loads.

In relation to these, the tests of a mechanical nature, carried out in our laboratory, show that the material in question has a performance far from negligible, also assisted by the presence of the double nets (fibre glass) with which the structure is reinforced.

It is therefore concluded the following;

- Biodesign technology offers a high degree of safety compared to the stresses generated by the thrusts of the soil and water;
- the product is free from overloads due to earth shifts under the pool;
- the shell composed of ground quartz and resin is able to easily support the secondary loads, such as the weight of bathers;
- the mechanical properties of the shell composed of ground quartz and resin are highly respectable;
- on the basis of the considerations made in this report, for ordinary projects, there is no need for additional structural calculations.