

Autoclaved cellular concrete as material of great potential – examples of ACC buildings constructed in Poland

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Abstract: This paper describes application of cellular concrete in construction of buildings of various types and designs. Properties of the material and previous experience are used to present the use of ACC wall elements for specific projects. Examples from the Polish market are given without indicating the manufacturer of the material used.

Keywords: Autoclaved cellular concrete, cellular concrete potential, use of cellular concrete, reference projects.

1. INTRODUCTION

This paper is an answer to recurring doubts about the potential and use of cellular concrete. Despite its popularity and a long presence on the market, autoclaved cellular concrete has been deprecated every now and again. Recurring opinions on the cellular concrete are sometimes very unfair and do not correspond with the facts. They are myths that need to be deconstructed again and again. This paper also provides evidence of what can be constructed with ACC. Because of the limited space, this article is only a partial presentation of the ACC potential.

As each country has its unique building style, the markets of construction materials are also diverse. Sometimes the differences are slight but sometimes they are significant. Therefore, this article was written based on experience and fields of application of ACC in Poland. The purpose of this paper is to show the style of buildings constructed in our country while presenting the possible applications and possibilities offered by ACC.

2. AUTOCLAVED CELLULAR CONCRETE – HISTORY

Cellular concrete is a relatively new material as compared to other construction materials (however, it must be emphasized that materials believed to have a long history such as clay materials but produced nowadays have not much to do with materials used at the beginning of the 20th century – only the name and composition are similar).

When talking about cellular concrete, one of the issues that have to be discussed is the evolution of the material over the years. In more than a hundred years of its history, autoclaved cellular concrete has changed. The production process has been changing and developing together with modifications of wall elements that have been changing to meet new requirements and adopt to new methods and trends in the construction industry. The current achievements in ACC production technology are certainly not the limit for the development of that material. For sure, there is still more space for progress and in the future, as the technology develops, autoclaved cellular concrete may offer more and more possibilities. This applies to both technology and application.

3. AUTOCLAVED CELLULAR CONCRETE – MATERIAL OF GREAT POTENTIAL

Investments in its development and production are best proof that the ACC will continue to be used in the future. New production facilities and investment projects aimed at the development of ACC implemented by rapidly developing countries and world economic powers show that ACC is a reliable material that can meet the requirements of a dynamic economic growth of those countries. Only reliable modern and environmentally friendly technologies and development prospects have a chance of being accepted by those countries. The basis for the development of ACC sector is an adequate level of knowledge required for complicated and demanding production process.

4. AUTOCLAVED CELLULAR CONCRETE – FIELDS OF APPLICATION

The main advantage of ACC is its uniformity and strength. It is surprising that those two features are not always noticed and appreciated. Very few wall construction materials have such distinctive features. Uniformity of ACC makes the material predictable and reliable in terms of technical properties. ACC wall elements in form of solid and uniform elements – blocks (and not hollow blocks) offer universal solution of great potential.

Thanks to its properties, ACC can be used to make elements of various functions:

- wall elements
- ceiling/floor elements
- roof elements
- filling elements for beam and block floors
- air-bricks

A range of ACC applications is very wide. When we focus on the use of ACC for the production of small-size wall elements, the basic products include: blocks, slabs, U-blocks, reinforced lintels. Those wall elements are used as structural material.

Compression strength is the only limitation of this type of material. However, that parameter is sufficient for the construction of multi-storey buildings. Regardless of the type of material used, a decision to use a given material should be based on a design analysis related to its technical properties.

Due to its physical and chemical properties (uniform and easily treated), ACC is a great material offering unlimited possibilities of shaping the body and the space inside a building. Also due to very good thermal insulation properties, ACC may be used as insulating material in internal partitions that fulfils the legal requirements and follows the latest trend for energy-saving construction.

5. TYPES OF BUILDING STRUCTURES FOR WHICH ACC IS USED

The Polish practice in the use of ACC in construction shows that that material is very often used to construct various types of buildings.

Types of buildings according to their intended use

- Single-family buildings
- Multi-family buildings
- Industrial buildings
- Buildings for livestock
- Commercial buildings (logistics halls, large volume buildings, etc.)

Types of buildings according to height:

- Low buildings
- Medium-height buildings
- Tall buildings (as infill walls)
- High-rise buildings (as infill walls)

Types of ACC structures:

- Load-bearing walls
- Partition walls
- Infill walls

Types of elements according to location:

- Foundation walls (basement)
- Overground walls

Types of elements according to function

- External walls
- Internal walls
- Load-bearing walls
- Partition walls

The above list shows that ACC wall elements have a wide range of applications in all types of buildings.

6. EXAMPLES OF ACC-BASED PROJECTS

6.1. Single-family buildings

ACC is a very popular material used for construction of single-family buildings. Simplicity of the construction process and the system-based solutions available on the market result in the material being widely used for construction of this type of buildings by small and medium construction companies. As the building process is very simple, the material is often used for construction of buildings by the investors themselves, without the help of building contractors, however, this approach is getting less and less popular.



Photo 1. Single-family building of ACC construction, system-based project by a small construction company

System-based construction process makes it possible to build single-layer and insulated walls. All elements of the system may be used: blocks, slabs, reinforced lintels, thin-layer mortar, and standard mortar. Both profiled and non-profiled wall elements can be used. The choice of technology depends on designers, contractors and investors.



Photo 2. Single-family building of ACC construction, system-based project by a small construction company



Photo 3. Passive building of ACC construction

6.2. COMMERCIAL BUILDINGS

ACC is also used for construction of buildings bigger than single-family ones. The prime example of an unusual project of this type is the so-called Crooked House (Krzywy Domek) built in 2004 in Sopot. The benefits offered by ACC were fully utilized in this project. Thanks to the uniformity of ACC a sophisticated front of the building could be built. This proves that ACC offers unlimited possibilities of shaping the building body and space. Clay, concrete or calcium silicate materials could not be used for this project.



Photo 4. The Crooked House in Sopot under construction. Front made of ACC.

The building was designed by Szotyńscy architects inspired by drawings by Jan Marcin Szancer. In 2004, in the heart of the famous Monciak, a building was constructed that gave the city a new face and made Sopot one of the most astonishing cities of the world. The Crooked House makes us unable to resist the magical and extraordinary charm and dream-like images. The building is considered to be one of the strangest buildings in the world and was placed at the top of 50 Strange Building List of the Village of Joy website. The Crooked House beat such buildings from all over the world as The Torre Galatea Figueres in Spain, the public library in Kansas City, USA and the famous Guggenheim Museum in Bilbao.



Photo 5. The Crooked House in Sopot, finished ACC front



Photo 6. The Crooked House in Sopot, finished ACC front



Photo 7. The Crooked House in Sopot, finished ACC front

The front wall was constructed using custom-made 30x30x60cm cellular concrete blocks. The wall width at its base is 120cm, while at the top – 40cm. The wall is a single-layer partition built with thin joint. After the wall was put up, the internal and external surface was ground with coarse sandpaper.

ACC may also be used for construction of public buildings based on reinforced concrete framework filled with ACC wall elements. In projects of that type, the load-bearing structure is made up of a structural system of reinforced concrete beams and columns. This structure is filled with wall elements. ACC is a perfect material for such

solutions. Due to its low weight by volume, ACC can be used to fill the structure without significantly increasing the load of the load-bearing framework.



Photo 8. Cycling track building in Pruszków. Reinforced concrete structured filled with ACC wall elements

BGŻ Arena indoor cycling track in Pruszków, with ACC used for the construction, was awarded the SPORTS VENUE OF 2009 title.



Photo 9. Gołębiewski Hotel in Karpacz. Reinforced concrete structured filled with ACC wall elements

Multi-storey buildings do not need reinforced concrete framework. Buildings can be constructed with load-bearing walls. ACC may also be used for such projects.

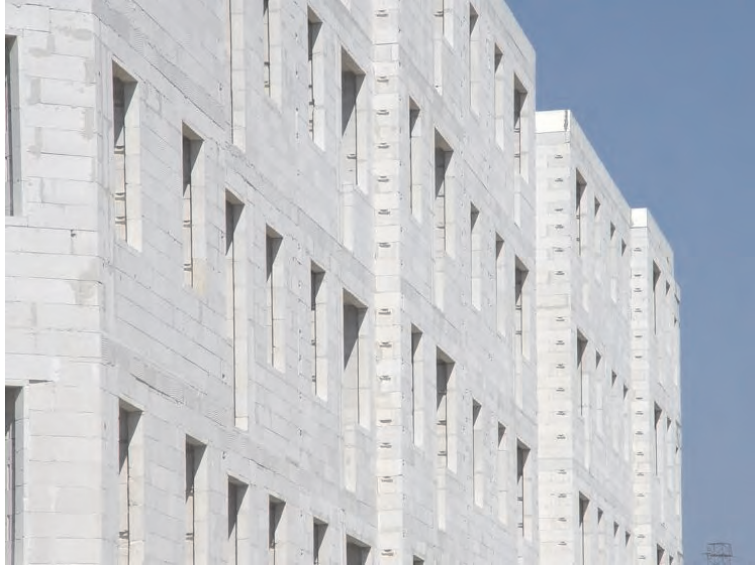


Photo 10. Multi-family building with ACC load-bearing external walls



Photo 11. Office building with ACC infill walls

6.3. Tall buildings

ACC is also used for construction of tall buildings, i.e. buildings taller than 25 m above the ground level according to Polish construction law. Over 55 m, a building is considered to be a high-rise building where ACC can also be used.

An interesting project for which ACC was used is an office building constructed in 1999 in the Warsaw city centre. The building is 112m tall (up to the roof) and has 28 storeys. It was designed by Vahap Toy and his team. The Millenium Plaza building is based on reinforced concrete structure with ACC infill walls.



Photo 12. Controversial building resembling shower cubicle as an example of application of ACC for high-rise projects

7. SUMMARY

The above examples show that ACC wall elements are very popular material used for construction of buildings of all types. Cellular concrete is more and more often used as a user-friendly and complete system-based solution. The examples support the

statement that ACC is a structural material offering almost unlimited possibilities. The material is appreciated not only by investors but also contractors and architects and is gaining in popularity.



Photo 13. Example of ACC structure of complex shape: sculpture made of concrete blocks shows how plastic ACC can be

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