

Advanced Facade Systems in Tirana, Albania

Nafiola Kumani¹, Bjora Tabaku², Klodjan Xhexhi³

¹(Structural Engineering/Polis University, Albania)

²(Structural Engineering/Polis University, Albania)

³(Architecture & Design/Polis University, Albania)

Abstract:

This article presents information about facades, their thermal insulating role in buildings in Albania. The facade in construction is one of the necessary factors to ensure a longer life of the buildings and indoor thermal comfort. Facade systems are composed of different materials, which provide a protective effect during the life of the building. The article will focus on the characteristic materials used in Albania for the construction of facades and the main materials used from the year 2000 up to today. The article will be informative, statistical and comparative in order to draw conclusions.

Nowadays building facades are again becoming one of main subjects of discussions, undoubtedly due to the increasing importance of the building envelope in relation to energy consumption. In the 90s, minimal attention was paid to the efficiency and quality of facades; everything was done strictly in relation to residency requirements. But, during this last decade, Albania had experienced a construction boom, with a series of good new buildings, which are accompanied by a progress in the architectural style and in the techniques of building materials usage. However, the advantages of facade systems in construction are not only to make the building long-lasting. The function of facades always undergoes changes and advances over time, in terms of its impact on the temperature fluctuations inside the building or energy storage.

Key Word: *facades, thermal insulation, ventilated facades, minimal energy, decorative*

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I. Introduction

During the 100-year period with the status of the capital of Albania, Tirana has gone through different historical stages of its development and transformation into a modern metropolis. Today's Tirana, history coexists with modernity, cultural heritage with new trends in urban development, but also diverse tourism, has transformed Tirana in the last decade, into a tourist attraction. In the last two decades, Tirana has also undergone changes in its appearance. Some of the buildings built during the communist era were painted in bright colors. The new city center square the multi-story buildings and other social- cultural buildings, the restoration of the main buildings of the ministries in the center of Tirana, the renovation of the New Market, the construction of the new stadium "Air Albania" and many other facilities, transformed Tirana into a modern metropolis which also attracts the attention and interest of foreign tourists from many countries of the world. The technology and materials for finishing the facades of houses are considered since at the design stage. The appearance of the building should fit into the landscape, be neat and beautiful. [1] In addition to the decorative function, facade decoration also performs purely practical tasks - it insulates the building, protects the supporting structures from moisture, wind, steam and extreme temperatures. The cladding of the facade must be hygienic, resistant to the destructive effects of fungi, mold, which often cause microcracks in the walls. When choosing a material for finishing the facade of the building, two important factors should be taken into account. First, the house must be in harmony with the surrounding area, look aesthetically pleasing and in accordance with the tastes of the owner. Secondly, the facade materials should become a protection for the house, playing the role of additional insulation and sound insulation, as well as protecting the supporting structures from moisture, sunlight and other negative influences. The city of Tirana incorporates interesting existing buildings such as the Twin Towers on the main boulevard of Tirana, ETC building and many other high-rise buildings. At the same time, it incorporates within the city, a number of residential buildings with ventilated facades, such as a 12-story building on "Barrikadat" street, another 9-story building near the Academy of Fine Arts, "Martirët e 4 Shkurtit" street, etc. The realization of advanced facades with minimal energy consumption and reduced capital investments in the near future will continue to be a challenge in architecture and technology. Generally, there are two types of facades in Tirana's context, ventilated and non-ventilated ones.

II. Material and Methods

1. AN OVERVIEW OF THE TYPES OF FAÇADE SYSTEMS

Engineers in Albania claim that the double wall system with polystyrene cover is frequently employed. For their multi-story structures, construction companies now choose to use ventilated facades. To reflect as much solar radiation as possible, external coverings are frequently constructed of ceramic tiles in light colors. In order to gain expertise, building businesses in Albania typically place orders for various kinds of ceramic tiles from outside. Several specialists, professionals, and even employees have received training in other nations [2]. Metal anchors with tabs designed to hold cover plates are fastened to a number of vertical posts in relation to the ventilated facades using specific nails. Vertical ladders are typically put in grooves to lower the cost of these systems; however, this has the drawback of focusing efforts on a small area (a few mm²). In certain cases, particularly when working with sandstone, the rear of the plate is machined to create inverted fractional holes that are then filled with screw anchors [1]. In other common façade designs, each tile is glued to a metal rail that extends over its full back, and the rail is subsequently fastened to the vertical legs. Last but not least, using the plate equipment requires time and money. The purpose of the invention is to provide a constructive solution to one or more issues so that vented facades may be built easily, inexpensively, and with no restrictions on slab size.

1.1 Types of facade systems

It is well known that ornamental purposes are among the most common ones for facades (visual). One of the earliest forms of cladding has a decorative use: facade plaster.

- Vapor permeability is a characteristic of this kind of plaster. Due to the wide variety of textures, its ease of use and accessibility, as well as its flexibility to be used in conjunction with other finishing materials, decorative plaster is one of the most prevalent, prioritized, and well-liked cladding options.
- Mineral plaster will hold up well to excellent training on wall surfaces and won't lose its marketability. It is utilized while completing a home that has been insulated with mineral wool or polystyrene foam [4]. With the inclusion of minerals and colors, it is made from a cement-sand mixture. A 10-15-year service life is typical.



Figure 1. Mineral plaster [6]



Figure 2. Acrylic plaster [7]

Little surface fractures are concealed with acrylic plaster, which is connected to elastic materials. It is simply mixed with plastic foam; mineral wool insulation is not used. The primary drawback is the buildup of dust, which is hard to remove and causes the facade to lose its color and luster. 15 to 20 years are the range for the service life.

- Everyone is familiar with ceramic bricks, which are constructed from backed clay. The material has many different color options, but this is not its only benefit. Further benefits include its durability, environmental friendliness, effective sound and heat insulation, and resilience to fire, sunlight, and high temperatures.
- Porcelain tiles are fire resistant and resistant to adverse external environmental influences.
- Metal facade cassettes are now often used for facing the facades of administrative buildings, but more recently they have also been utilized in private structures.
- Metal side walls offer strong resistance to harsh temperatures



Figure3.Metalfaçadecassettes [8]



Figure4.Porcelain tiles [9]

➤ **2.2 Regarding the installation technology, the following facade systems are**
Sandwich panels are a form of double-sided protection and thermal insulation.



Figure5.Sandwich panels [10]

- "Wet facade": the insulation is laid on a surface that has already been treated, and it is then plastered over the reinforced coating.
- An air gap between the inner and exterior walls, one of the structural features of ventilated facade systems, is present. Every choice for the facade system is based only on the installation of individual materials. Direct mounting of sandwich panels occurs on the facing material. The installation of insulation from the outside is the foundation of the "wet facade system." Galvanized steel or vinyl-based plastic are both used to make panels. Nonetheless, aluminum facade systems are the most dependable and stable in use. They do not burn, are not prone to corrosion, and can withstand little mechanical damage [2]. Aluminum panels are adequately protected against atmospheric impacts by powder coating. Also, a wide variety of colors makes it possible for you to select the ideal solution for finishing the facade.

2.3 *Ventilated facades*

A sort of advanced façade with natural ventilation known as a ventilated facade is one in which the air gap between the wall and the roof is constructed so that the chimney effect causes the air within to flow (stack effect). A building structure is divided from a continuous facade by an air gap and is covered with ventilation. At the cover's two ends are two slots that allow air to flow continuously. The heat from the radiation is reflected from the outer covering in the vented area that is directly exposed to solar radiation. At least 20% of the air conditioner's heating and cooling loads may be reduced with the use of energy reflection, building structure shadows, and natural ventilation. Winds increase the top part's pressure (calculated for objects from 10-20 m 0.2- 1 Pa every meter). The issue of energy loss from the inside of the structure is resolved by adding an insulated layer in the air gap [3]. Also, the evaporation produced inside the system is exported via the ventilation in the air gap.

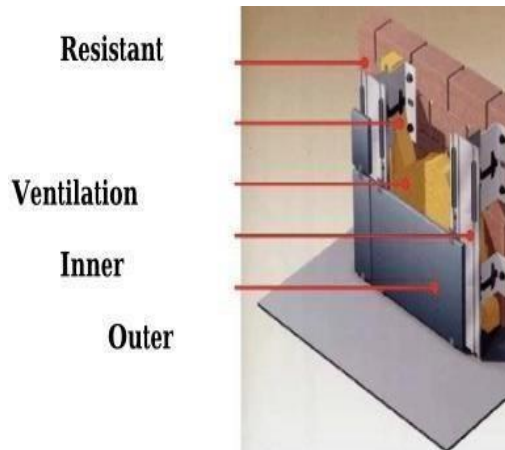


Figure6. Ventiladedfacades [11]

Advantages of ventilated facades:

- Reduces the likelihood of facade fractures;
- The elimination of thermal bridges; - Protection of walls from atmospheric pollutants;
- Get rid of interior condensation;
- Timely external insulation efficiency;
- Simple installation despite climatic issues; - Individual tile maintenance and replacement
- Operation without further maintenance for 45–50 years;
- Good thermal insulation capabilities, keeping the building cool in the summer and warm in the winter; protection from hostile forces and corrosion prevention;
- Protection against numerous environmental variables, such as humidity, melt water, condensate masses, and the suffocation of the retaining wall; • A 30% increase in energy efficiency and savings in heating;
- Enhance sound insulation capabilities;
- Excellent level of fire safety due to the use of non-combustible elements in the design;
- A decline in performance;
- The ability to install both during the summer and the winter;
- Materials for a ventilated façade that are simple to disassemble and reuse; a variety of coping materials, such as aluminum panels, natural stone, porcelain stone, etc.; and the ability to employ a dark-colored finish without the building being overheated in the summer.

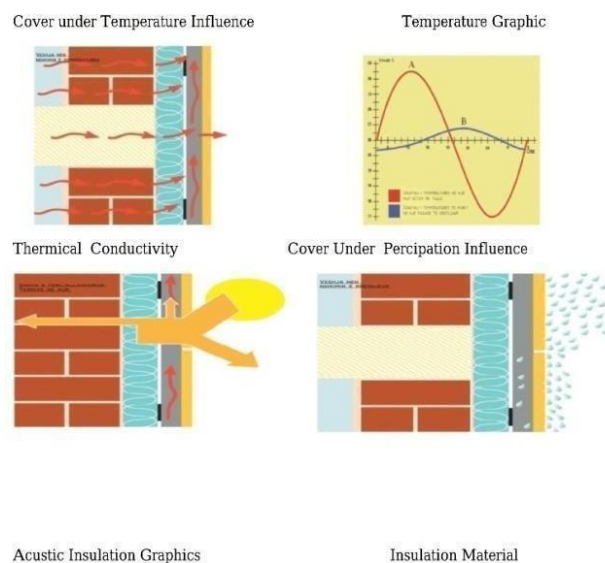


Figure7. Ventiladedfacadesperformancefacades [12]

2. TYPES OF VENTILATED FACADES. CASE STUDY TIRANA

Square 21. Square 21's vented façade provides long-lasting durability, good energy efficiency for heating and cooling, minimizes moisture buildup, and a variety of alternatives for the building's design.



Figure8. Building of 12 stories, at the "Barricada" Street; Tirana [13]

TowerBridgel

The vented façade, also known as the "double skin" facade, is a structure that has two outside layers that are separated from one another by an air chamber. High longevity and durability of the object due to great protection from climatic, chemical, and physical variables are two advantages of this method. Rain, wind, and other elements are never able to reach the facade's inner layer. Low energy requirements to keep the surroundings at a steady temperature, which greatly reduces your electricity costs. As the inner layer of the facade is not directly exposed to the outside environment, the permeability of temperature is significantly reduced. The second layer of the air chamber and acoustic insulation greatly limit the amount of noise that is transmitted from the outside to the interior.



Figure9. TowerBridge1[14]

Measurements with specific instruments

The instrument of measuring (Indoor air temperature): Digital Lux Meter

The instrument of measuring (The temperature of the outer wall): Mestek, Infrared Thermometer.

Moisture level of indoor walls: Silverine, Digital Moisture Meter

Building: ARLIS 21, ventilated facade

North-South Data: 10.02.2023 Indoor air temperature: 22.2°C

The temperature of the outer wall: 13.8 °C Outside air temperature: 5 °C

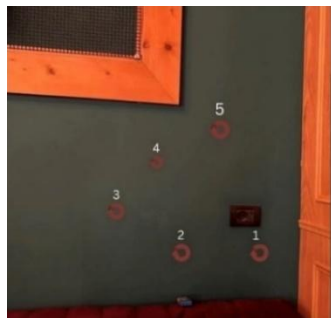


Figure 10. Square21, Tirana, Source: Authors



Figure11. Wall composition [15]

Point	Moisture level of indoor walls (%)	Surface Temperature of indoor wall(°C)
1	9	19.6
2	7	20.6
3	3	21.8
4	5	21.5
5	6	20.8

Table 1. Measurements of moisture and surface temperature, ARLIS 21, source: authors

Building: Condor Center, Street "NdreMjeda"

North-South

Indoorairtemperature:20.3°C

Thetemperatureoftheouterwall:6.5°C

Outsideairtemperature:2°C

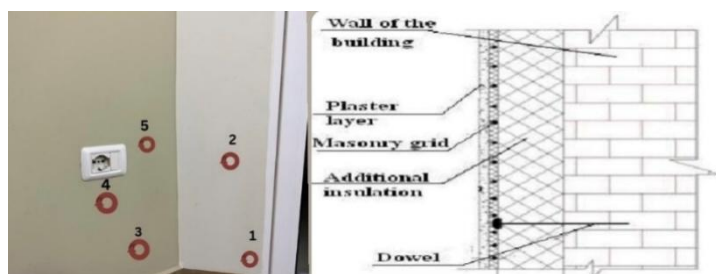


Figure.12CondorCenter,Tirana, Source:Authors Figure.13CondorCenter,Tirana [16]

Point	Moisture level of indoor wall (%)	Surface Temperature of indoor wall(°C)
1	14	15.2
2	11	15.9
3	10	16.4
4	6	19.6
5	9	18.9

Table 2. Measurements of moisture and surface temperature, Condor center, source: authors

According to the measurements made with the above-mentioned devices, are extracted the results that are presented in the Table 1 and 2 of each respective building. Through a comparison between the average humidity values of the two buildings, it is observed that "Square 21" has an average moisture value = 6%, while the "Condor center" = 10%.

"Square 21" has a lower average value than "Condor Center", which means that the insulation against moisture is more efficient. This is because the facade of the building is ventilated. Whereas the facade of the Condor Center is an unventilated facade, the masonry of which is made of brick, plaster, thermal insulation, and a thin layer of water insulation represented by the plastic paint. For this reason, the insulation against moisture is lower compared to the ventilated facade.

According to the average temperature of the wall surface, comparing it with the ambient temperature of each building, it is noticed that "Square 21" has an average temperature of 20.86°C and a difference of 1.34 °C with the ambient temperature, while "Condor center" has an average temperature 17.2 °C and a difference of 3.1 °C with the ambient temperature. Furthermore, the wall surface temperature of the "Square 21" building has a very small difference compared to the ambient temperature.

Taking into account the above results, isolation against moisture and temperature fluctuations in the building with ventilated facades are more efficient and effective compared to non-ventilated ones.

III. Result

According to the experts, the usage of ventilated facades is recommended. Their expenses are somewhat high—between 50 and 100 euros per square meter for horizontal surfaces and between 120 and 135 euros for vertical facades—but they are declining because of the seasoned craftsmen employment. Under such circumstances, it is crucial to create many layers using materials with various thermal coefficients and thicknesses. The conclusions drawn from the examples suggest that rockwool is a superior thermal insulator material versus compressed polystyrene. Furthermore, the building benefits from greater energy savings.

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