Brequigny high school

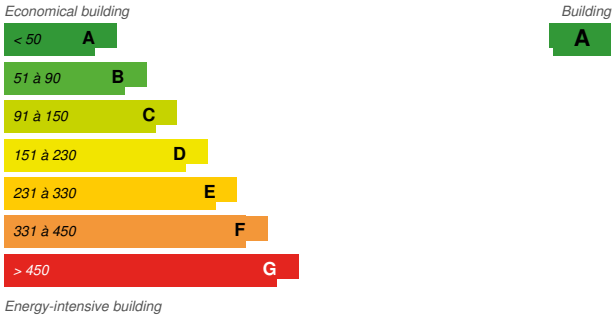
by Xavier DAVY / 2021-03-18 15:53:54 / France / 12364 / FR

Primary energy need :

43.9 kWhep/m².an

(Calculation method : RT existant)

ENERGY CONSUMPTION



Building Type : School, college, university
Construction Year : 1958
Delivery year : 2020
Address 1 - street : 7 avenue Georges Graff 35200 RENNES, France
Climate zone : [Cfb] Marine Mild Winter, warm summer, no dry season.

Net Floor Area : 19 580 m² SHON
Construction/refurbishment cost : 20 000 000 €
Cost/m2 : 1021.45 €/m²

General information

This building was awarded the Sustainable Renovation Grand Prize of the Green Solutions Awards 2020-21 at the national level; and a mention for the same category at the international level.

Located in Rennes, the Bréquigny high school has 3,500 students and is the largest high school in Brittany. Built in 1958, its renovation became essential to sustain the reception of students.
The project as a whole concerns:
• the energy renovation of part of the day school and housing buildings
• the rehabilitation with change of use of the current catering building into a foyer, multifunction room, agent pole, professors' space and permanent contracts
• the creation of a new catering center
Egis has established an innovative rehabilitation model that can be reproduced in other educational buildings. A solution that offers an energy level identical to that of a new building, a very low carbon level, a controlled implementation based on the “off-site” technique (see “solutions” tab for the characteristics of this envelope). A solution that guarantees cost and time control on an occupied site, and performance monitoring during the operational phase to guarantee the objectives.

Sustainable development approach of the project owner

Initial training is an essential asset for Brittany in terms of access to employment: the Brittany Region devotes nearly 1/4 of its budget to this. Owner of the Bréquigny high school in Rennes, the largest Breton high school with 3,000 students, **the Region is initiating a work program there in 2018 intended to improve the reception and comfort conditions of its users in** accordance with **axis 1** of its real estate master plan .

It is within this framework that a single contract was awarded to a consortium for the design, construction, operation and maintenance, following a competitive procedure with negotiation lasting 12 months. This global market without allotment led to a saving of time in the realization of the project. The **collective carrying over 6 years of performance commitments makes** each member of the group accountable.

The main orientations of the client are as follows:

- User health - quality of life inside the establishment
- Energy - design a bioclimatic, efficient building and reduce consumption
- Managing water, waste and green spaces - adapting to your environment
- Reduce the impact of the site on the operation of the site and on the environment
- Eco-management - facilitate upkeep and maintenance

Architectural description

Aesthetic modernization

The aim of the group's project is to develop the influence of the Bréquigny high school by enhancing its image within its neighborhood. Built in 1958 by the architect Louis Arretche, it has undergone multiple changes over the years which have respected the unity of its buildings. The project will keep this continuity and the history of the school by striving to keep a modern and evolving constructive logic.

Low impact linked to the construction site

One of the challenges of this project is the management of the intervention on an occupied site. Indeed, the objective is to avoid the installation of expensive temporary premises and to operate as quickly as possible. In order to achieve this objective, the group has chosen to implement a system of prefabricated modules and industrialized finished products. The modules that make up the facades will be partially clad, insulated and glazed, and will be attached to the existing facade. Then the old windows will be removed and removed and industrialized cladding frames for the interior finish, including blinds, will be installed, room by room.

A protected plant heritage

All the plantations envisaged for the project are adapted to the local climate and require little maintenance. Shaded beds will participate in the atmosphere of undergrowth of the place and the wooded plantations made up of pedunculate oaks, hornbeams and ash trees, will complete the existing wooded frame.

The intervention aims to achieve a significant improvement in operation by adding vertical circulations and heat, by installing insulated and prefabricated caissons allowing intervention on an occupied site.

For each building, a formal metal profile language is developed based on the amplitude of these curves.

Each type is also available in 3 different profiles from commercial products under technical advice:

For building C, north facade, A profiles are used. The amplitude is less; they will catch the light evenly.

For buildings C and A, east and west facades, B profiles are used. The amplitude is greater; the effects of light and shadow are more important and changing throughout the day.

Finally, for building C, a noble facade to the south, the C profiles are used. The amplitude is the greatest; it allows for graphic interplay of radical blacks and whites, and draws a more ornamental facade.

This horizontal shiny metal material is associated with vertical lines of matt metal (zinc). This assembly gives the identity of the facade by reinforcing the perspectives and the play of shadows and light. This dark-looking facade will actually reveal light.

Building users opinion

The thermal and visual comfort is particularly appreciated by the occupants, who quickly forgot the old "thermal strainer" and now have a high school as efficient as a new building.
The air quality has also been reworked, in direct connection with the improvement of the performance of the airtightness of the envelope.

If you had to do it again?

The project is precisely designed to be replicated! As part of the France Relance Plan, the Eco-Energy Tertiary system and more broadly the immense need for thermal and energy renovation of the French building stock, this project is a pilot operation and foreshadows the renovation methods for the years to come.

See more details about this project

https://www.egis.fr/convictions/transition-energetique/lycee-brequigny-un-modele-de-renovation-reproductible-resilient
https://www.sembreizh.fr/actualites/detail-d-une-actualite/lycees-le-projet-brequigny-en-video.html
https://www.egis.fr/action/actualites/gpni-2020-egis-prix-lycee-brequigny
https://www.groupe-legendre.com/realisation/lycee-de-brequigny-renovation-du-lycee-et-creation-dun-restaurant-scolaire/

Photo credit

Dimitri LAMOUR

Stakeholders

Contractor

Name : Région Bretagne
Contact : Valérie CALAGE
https://www.bretagne.bzh/

Construction Manager

Name : Egis
Contact : Jérôme DIOT
http://www.egis.fr

Stakeholders

Function : Designer

Anthracite Architecture

Nicolas THEBAULT

http://anthracite-architecture.com/
Design + architectural monitoring of works

Function : Construction company

Legendre Construction

Hilaire MENAGE

https://www.groupe-legendre.com/
General contractor representative of the group

Function : Company

CCL Constructions

Eric DUBOST

https://www.ccl-construction.fr/
Manufacture and installation of timber frame facades

Function : Contractor representative

Sembreizh

Amaury HUET

https://www.sembreizh.fr/
Delegated project management

Function : Assistance to the Contracting Authority

ALTEREA

https://www.alterea.fr/

Contracting method

Other methods

Energy

Energy consumption

Primary energy need : 43,90 kWhep/m^2.an

Primary energy need for standard building : 88,80 kWhep/m^2.an

Calculation method : RT existant

Breakdown for energy consumption : Heating: 32.4 kWhef / m² / year Lighting: 2.44 kWhef / m² / year Auxiliary Heating: 0.54 kWhef / m² / year Auxiliary Ventilation: 1.97 kWhef / m² / year

Initial consumption : 157,00 kWhep/m^2.an

Real final energy consumption

Final Energy : 37,00 kWhef/m^2.an

Real final energy consumption/m2 : 37,00 kWhef/m^2.an

Real final energy consumption/functional unit : 37,00 kWhef/m^2.an

Year of the real energy consumption : 2 020

Envelope performance

Envelope U-Value : 0,56 $W.m^{-2}.K^{-1}$

More information :
Existing concrete frame isolated from the outside by a timber frame wall. High inertia building Wood frame wall added to existing wall with 240 mm glass wool (120 + 120): Up = 0.21 W / m².K Roof insulation with 260 mm glass wool: 0.16 W / m². KIsolation Low floor in crawl space in flocking of 120 mm with insulation of 3-sided beams: 0.29 W / m². K Joinery: Ug = 1.1 W / m² ° C / TI = 70% / FS = 33 in the South and 65 in the North / Uf = 1.8 Wood-alu

Building Compactness Coefficient : 0,60

Indicator : I4

Air Tightness Value : 1,09

More information

Monitoring of consumption according to the IPMVP protocol framed within the framework of a Global Performance Market (MGP). Monitoring is done according to the feedback of meters defined in the metering plan of the IPMVP protocol, with energy report every year.

Renewables & systems

Systems

Heating system :
- Urban network

Hot water system :
- Urban network

Cooling system :
- No cooling system

Ventilation system :
- Single flow

Renewable systems :
- No renewable energy systems

Other information on HVAC :
Heating system produced by a biomass heating network. Variable flow pump installation. Regulation of the radiators by 2-way valve with self-regulation of the flow rate independently of the network pressure, connected to a room sensor controlled from the BMS. Regulation of the extraction air flow by shutter controlled by an analog signal allowing the air flow to be regulated independently of the pressure of the aeraulic network. The flow can be adjusted from the GTB.

Heating network using 56% renewable energy.

Solutions enhancing nature free gains :
Les gains passifs en énergie se font par: l'isolation renforcée des parois (mur, plancher, toiture), le remplacement des vitrages, le contrôle de l'étanchéité à l'air, l'isolation des tuyauteries.

Smart Building

BMS :
Installation of a building management system to control, control and manage technical alarms. The energy meters are sent back to the GTB allowing energy monitoring in accordance with the IPMVP. Use of a digital twin allowing the recalculation of the reference consumption according to the measurements (outside temperatures, schedule of use ...). Implementation of an Energy Management System (EMS) / Building Operative System (BOS) allowing the monitoring of energy consumption with the Client.

Smartgrid :
Creation of a Dig Data for data management allowing energy monitoring

Environment

Urban environment

Land plot area : 200 000,00 m^2

The Bréquigny high school is the largest high school in Brittany. It covers almost 20ha and accommodates more than 3,000 high school students. Its name, like that of its district, is inherited from the name of the seigneury of Bréquigny. The school is built on the site of the castle and its outbuildings.

This school project was born within a larger framework, of construction of an entire district, organized with a stadium and a public park surrounding the future equipment. Since its creation and its many evolutions, the school has energized the Bréquigny district with a wide influence. Our first intention will be to develop this influence by enhancing the image of the building in the neighborhood. A high school should be proud, timeless and powerful.

The buildings were constructed in several stages of expansion. All have known how to respect their elders and follow through on them, which has made it possible to produce a unitary site image today. All the buildings of the Lycée Bréquigny present a sober and tense script, revealing the obvious quality of the plant context and reinforcing the idea of a campus.

Our general approach has been to maintain this continuity by striving to keep a modern and evolving constructive logic by facade, but presenting the same qualities of efficiency and formal simplicity as the existing one, with the aim of making the image evolve. school while respecting its history.

A high school is also an identity that is passed on from generation of high school students to generation of high school students. These years of study mark the life of each of us. Working on the image of a high school also means integrating this temporal dimension and this emotional relationship of each.

Our ambition for Bréquigny is to give it back an image of elegance and rigor. For having already realized it, we know that black emerges an image of sobriety which makes of it a color very indicated to affirm these attitudes. We therefore worked all the buildings in a pigmentary coherence for which the lights of the black are expressed by their brilliance, their mattness and their depth linked to the properties of the metals we used: zinc, aluminum and steel.

These materials are a guarantee of durability and ease of maintenance for facades. Each entrance to the project is marked with a clear mineral material, the equipment of which refers to stone.

Products

Product

Prefabricated timber frame facade

CCL Construction

Tel : 02 99 76 70 10 / mail : ccl[a]ccl-construction.fr

https://www.ccl-construction.fr

Product category : Gros œuvre / Structure, maçonnerie, façade

From the first phases of the studies, the reflections are directed towards a process of mantle walls with wood frame for the insulation of the facades of the buildings, because it is the constructive mode which will make it possible to achieve the primary goal of the project: a significant improvement in the building's energy performance, with a low-carbon construction method, a process that had already been developed a few years earlier during the pilot project for the thermal renovation of Colbert high school in Lorient, a process that can be massively reproduced on other buildings with the same typology. The wooden frame facades, the FOB, are boxes made of a wooden frame, in which is integrated the thermal insulation of the facade, the air and water tightness devices, the exterior joinery, and finally everything that will make the exterior finish of the facade, its architectural side.It is a process that lends itself particularly well to the typology of the building which is the largest high school in Brittany: a great length of building, not very high, very repetitive in its length and characteristic of the constructions of the 1970s in precast concrete. A box corresponds to a storey height, its dimensions allow it to be loaded on standard heavy goods vehicles with a lowered platform, and thus reduce the cost of their transport. Beyond the technical solution, it is also the manufacturing method that been thought out, relying on off-site construction. The major advantage of the FOB is that it is almost entirely manufactured in the workshop, outside the construction site, which makes it possible to limit the nuisances on site, site occupied and in activity throughout the duration of the work, to significantly reduce the on-site response time and the overall duration of the site A short circuit was favored by working with a local company which is close to the site. The FOB model is thought out and designed to be simple, sober and efficient. This simplicity allows, very early in the studies, to concentrate on the development of details and the management of singular points. To do this, the project must be thought through in its implementation: method of fixing the caissons, junction of two juxtaposed caissons, treatment of the angles. It is all these reflections that will lead to an intelligent project according to the DfMA concept - “Design for Manufacturing and Assembly” - “Design for production and assembly”. The mode of grouping of the project in design-construction, in which engineering is associated with the construction company from the genesis of the project, allows the builder to be involved in our reflections. The construction method is thus developed by following the manufacturing processes of the construction company as closely as possible.

All stakeholders were won over by the process, which secures costs, deadlines and quality of execution. The site was carried out in a very unintrusive manner for the occupants, which perfectly met the constraints of the operation's occupied site.

Costs

Construction and exploitation costs

Total cost of the building : 20 000 000 €

Health and comfort

Indoor Air quality

No intervention on the interior coatings as part of the operation. Integration of a fresh air flow higher than the standard: 600 m3 / h per classroom.

Comfort

Health & comfort :

The airflow in each classroom has been sized so that the instantaneous CO2 build time does not exceed 1300 ppm for more than 15 minutes.

A flow rate of 20m3 / h per student and 25m3 / h per teacher was retained.

Calculated indoor CO2 concentration :
1200

Measured indoor CO2 concentration :
1150

Calculated thermal comfort : Température de 20° en hiver et moins de 3% du temps inférieur à 28°C en été.
Measured thermal comfort : 20° en hiver et 29°C en été

Acoustic comfort :

Acoustic comfort complies with the decree of April 25, 2003 relating to the limitation of noise in educational establishments.

Daylight factor : FLJ égale à 2% sur 80% de la surface de premier rang

Carbon

GHG emissions

GHG in use : 7,83 $KgCO_2/m^2/an$

Methodology used :
Scope = consumption of heating (Rennes south urban network), lighting, ventilation and auxiliaries + construction products and equipment during the operation phase

GHG before use : 295,00 $KgCO_2 /m^2$

Building lifetime : 50,00 année(s)

, ie xx in use years : 37.68

GHG Cradle to Grave : 686,00 $KgCO_2 /m^2$

Quantities of companies for the structure and architectural lots (detailed method). Ratio approach for technical lots on the basis of E + C- flat rate data (simplified method). Source of environmental data: INIES exclusi database

Life Cycle Analysis

Material impact on GHG emissions :
409

Material impact on energy consumption : 5 776 340,00 kWhEP

Eco-design material :

The building is insulated by prefabricated wooden frame caissons, which makes it possible to incorporate a large mass of bio-based material into the project and to store carbon in the building.

Contest

Reasons for participating in the competition(s)

The project responds in a relevant way to many concerns of the current construction sector: ensuring a sustainable character of buildings, guaranteeing reproducibility of the techniques implemented, responding to economic reality at an affordable cost and exploiting the latest innovations to develop the construction sector...

Many themes are thus present in the operation:

- An environmental issue thanks to a low carbon renovation. The level is 409 kgCO2éq / m². A lower level than the construction of a new very low carbon high school (Level C2 of the E + C- label is 750 kgCO2éq / m²).
- An energy challenge by reaching an energy level, after renovation, equivalent to a new building (40.5 kWhEP / m² / year of actual consumption)
- An issue of comfort, health of users, and their involvement in use.
- An issue of quality guarantee, time and cost of construction. The use of off-site prefabrication makes it possible to reduce technical uncertainties, facilitate intervention on an occupied site, and control costs, completion time and quality.
- The challenge of controlling the overall cost of maintenance and operation.

This solution has proven itself in terms of environmental impact. It demonstrated that the renovation of a high school had a less significant impact on the climate than the construction of a new very low carbon high school with the same energy performance.

In 10 months, 10,000 m² of occupied site were renovated, using a unique methodology that can be replicated to most school facilities built over 20 years ago

This model thus represents a real response to the revival of a resilient economy, with the cost of production and operation optimized, and duplicable.

Building candidate in the category

Energie & Climats Tempérés

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