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BIM - NZEBuilding: Application of the BIM methodology for the construction of a school after the earthquake

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Introduction: object and objectives of the project

The aim pursued in the development of the case study design is to create a school center with "almost zero energy" (nZEB) through the use of methodology (BIM from 3D to 6D) which, on the one hand, reduce the risk of errors in the design phase and, on the other hand, prevent subsequent time and cost extensions in the construction phase and allow for a detailed and updated energy analysis. This last point is essential for both the design phase and the facility management phase.

These objectives are fully achieved through the construction of a high school of first degree, located in the historic part of the city of Teramo (IT), which will replace the existing one but damaged and rendered unusable by the earthquake of 2016. Below of this will be installed a car park for public use which will increase the availability of stalls in an area that has a shortage. The site where the project will be built is that of the old municipal stadium, located within the historic center of the city of Teramo, around which it will be appropriate to modify the road network aimed at solving some small problems.

Analysis and Methodology

In the first phase, the territory of the city was studied to analyze and, therefore, solve the criticalities of the city. From the aforementioned analysis it emerged that, due to the earthquakes that followed one another from 2009 onwards, there was the decentralization of some public services, including the high school F. Savini, whose location has damaged the gastronomic services and small neighboring foodstuffs causing, in some cases, the closure. The transfer of the institute (2 km from the historic center) also prevents children from perceiving life within the "city walls" as well as the loss of the professor-student cultural interaction through the historic streets of the city (museums, historical monuments , archaeological excavations, etc.). Subsequent analyzes have also highlighted the critical situation of the stalls; in fact, the historic center of Teramo is served by three multi-storey car parks (two of which are outside the walls), a large level parking lot (used on weekdays for the city market and other recreational and artistic events) and other small stall areas. All these services are able to satisfy about 80% of the demand, however, by studying the layout of the largest car parks, it is immediately evident that there is an area of the center far from the latter. The aforementioned area is precisely that of the old municipal stadium, now in a strong state of deterioration because it has been replaced by a new state-of-the-art stadium located outside the inhabited areas.

Subsequently, the technologies to be used both in the design phase and in the use phase of the building were studied. All the advantages deriving from the BIM methodology and the “almost zero energy” buildings were analyzed and understood; in both cases it has been seen that the major tasks present in the design phase will bring an advantage in the use phase of the building. All this thanks to the virtual information model of the building and the energy solutions adopted that minimize energy demand and therefore also the maintenance and deterioration of mechanical systems

The case study: New school's Designing

The project aims to create, through BIM, an nZEB school complex with an adjoining parking for public use.The building above ground will be used as a high school for about 500 users (5 sections, 15 classrooms). The main entrance faces south where there is an imposing staircase "cut" into three parts by a ramp for the disabled at the foot of which a square and a quick stop area for buses and cars have been created. Finally, two further secondary accesses will directly serve the building. The entire building will consist of a main block consisting of three floors with north-south orientation and three transverse blocks from one floor in which activities for collective use will be inserted, while the gymnasium, externally similar to the transverse blocks, will be higher and it can also be used independently. The 15 classrooms will be exposed completely to the south and located on the first and second floors, while the laboratories will be located at the top of the main block. For each of the three transversal blocks of the ground floor a different activity is envisaged and the two eastern blocks also have independent accesses both to be able to use them outside school hours and to use them as service access or emergency exits. . The multipurpose gym will also have its autonomy as, in addition to school sports activities, it will have parallel access that will allow it to be used outside of class hours. Finally, the

external part of the building will be equipped to the south with two play areas for children and relaxation areas, and to the north with an athletics track and an equipped sports course.

In the basement level there will be a parking lot with 170 stalls, the accesses to it are four: two pedestrian to the south, one pedestrian with ski lift to the north and one both pedestrian and vehicular with access control to the east. From the car park it is possible to directly access the school and gymnasium to avoid congestion in the main road network, which will also be modified in front of the driveway, replacing the car park currently present with a roundabout that simplifies entry and exit from the new area stop.

The entire project was carried out with BIM methodology and, through clash detection, and model checking, the various phases (architectural, structural, systems) were adequately integrated, avoiding errors and interference that would expand costs and construction times. The first phase involves the architectural design using a specific software in BIM and subsequently, integrating it with other software that use the same technology, the transition to structural design (plug-in) takes place. Both results are then transferred to a third software that verifies the absence of interference that could damage the construction or usability of the building in question. The same architectural project is then integrated with other software, which analyzes the lighting and its consumption, the thermal and acoustic performance of walls and floors, the correct use of renewable sources; having taken all these analyzes into consideration, the appropriate checks required (lighting, acoustics and heat) are carried out with the related drafting of the reports according to the regulations in force.

In conclusion, from the application point of view, the tools used for the realization of the project simplify and combine the work of the various "actors" present, while from the energy point of view, cutting-edge materials and technologies with low environmental impact are used that minimize the maintenance costs of the building and make it a point of reference and awareness for future constructions.

Conclusions:

“BIM is therefore a methodology, characterized by the cooperation of all the players in the supply chain, which through its dimensions supports the construction and management of the work throughout its life cycle.

Citing a statement by Mark King - BIM Solutions Manager at Leica Geosystems, "a greater commitment is required in taking BIM out of the studio by experimenting it directly in the field of action". This experimentation translates into the Kemp's concept for BIM. The acronym BIM, in this case stands for Better Information Management or better information management for each element involved in the design. Therefore, in addition to the considerable commitment on the part of the designers, who will be subject to continuous training especially in the field of BIM, there must be the foresight and the complicity of the client with the BIM manager as occurred in the case study described.” (Metodo BIM: gestione dei cantieri edilizi nei centri colpiti da calamità naturali. Lucarelli M., Laurini E., Rotilio M., De Berardinis P. . Convegno Reuso 2018 Messina (IT).