Development of a natural disasters resilient school prototype for central Chile

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ABSTRACT

It is proposed a prototype of school building which is resilient to natural disasters in the central zone of Chile. One of the most important considered aspect is the capacity of the building to keep working through and after critical events so it can provide help to community. Hereby it was designed as an off-grid building, with a high energetic performance standards.

KEYWORDS

Educational buildings, Resilience, Shelter, nZEB, Sustainability.

RESEARCH PROBLEM

It has been seen that built environment is directly related to the resilience of communities which inhabit it [1]. In Chile schools plays an important role in that context, being used for communities before and after natural disasters. However, many schools has not proper infrastructure to afront this situations being forced to stop classes and giving poor living conditions as shelter. In this context is necessary start to design prepared buildings that could contribute to community recover after natural disasters.

OBJECTIVE

Elaborate a prototype of school building for central zone Chile. Following the *passivhaus* standard, must have a low energetic demand which will be covered by renewables, and a high comfort performance. It must be used as shelter without stop classes

ASSUMPTIONS

1. Under normal functioning, building works on-grid as nZEB. Under emergency functioning, it works off-grid as NZEB.
2. Function in summer period implies 60% of the building working. Energy back-up system has been designed for that.
3. It has not considered economic factors in design.

MODELING AND SIMULATION

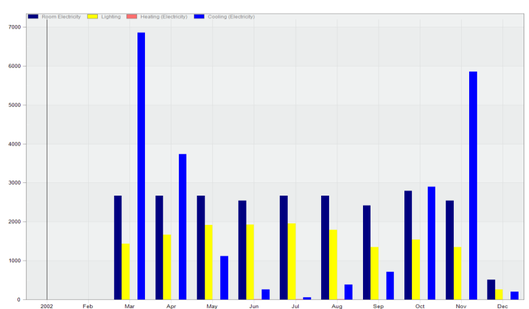


CHART 1

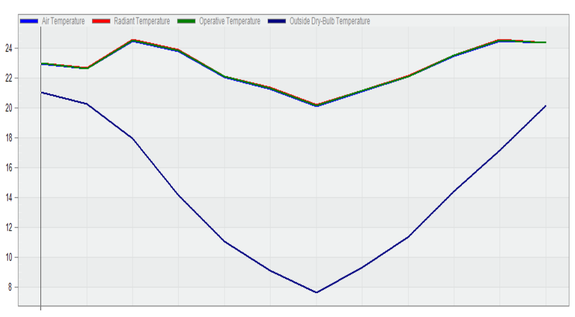


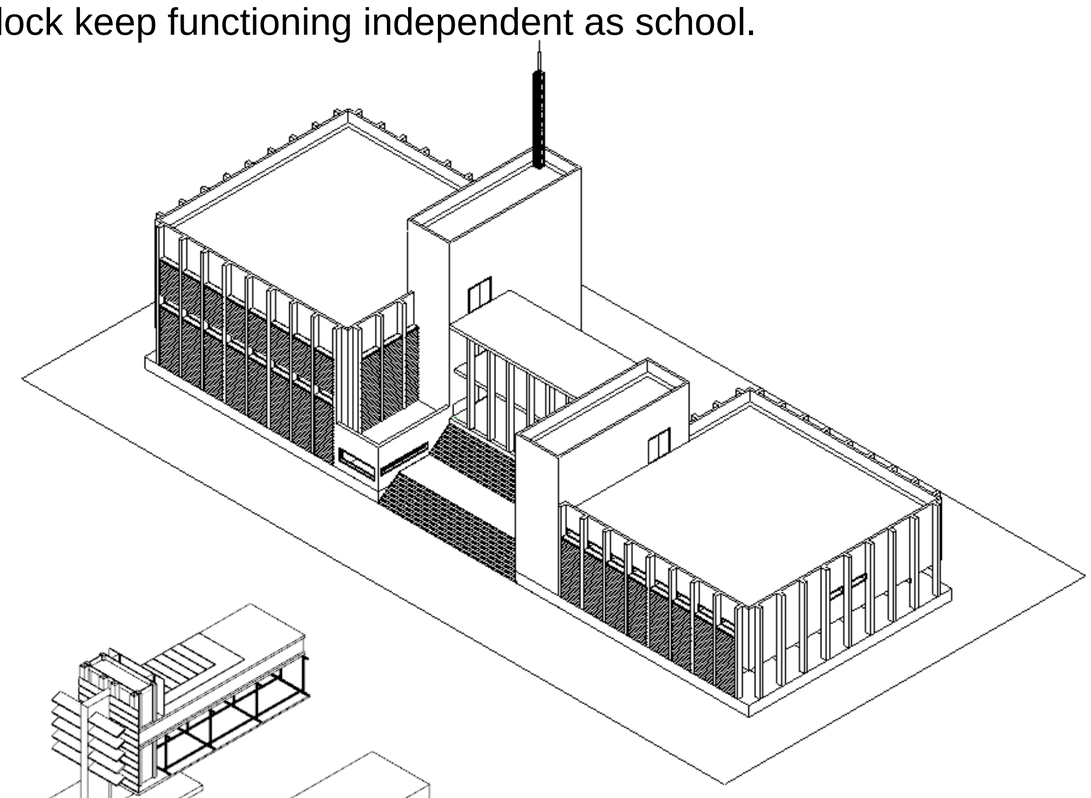
CHART 2

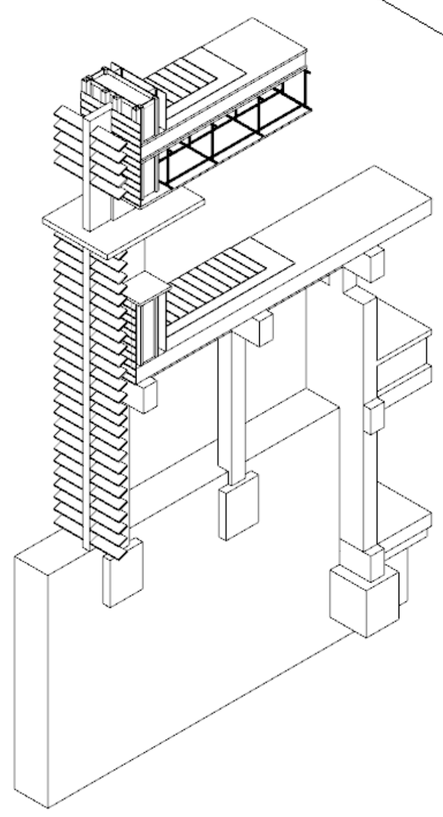
Prototype was simulated via Design Builder, determining that principal load is cooling and there is not heating loads. Furthermore, average operative temperature inside classrooms are within comfort band (chart 1) following Szokolay adaptative comfort model[2]. By this, it was possible to determine that prototype can works only with cooling system.

It was considered distinct scenarios of operation by its work in regular or critical conditions. It was obtained that critical operation is more demanding than regular in energetical terms.

PROTOTYPE DESCRIPTION

School-building prototype consists in two masses connected by a bridge. First of them contains all educational rooms and the second one, the tallest, administration and services. In front of an emergency event bridge connection will be closed and services block will be used as community shelter, allowing other block keep functioning independent as school.





School has a modular system using OSB construction panels. Exterior walls and flat roof are insulated by 37 cm of cellulose: interior walls insulation is used as an acoustic solution. Windows are triple glazing 6 mm clear glass with air gaps. is the highest the year. This highly insulated construction demands about 30 kWh/m2 which is covered by 540 m2 of photovoltaics installed above the roof.

School has an UPS system of OPzS batteries and a diesel motor as a back-up system also. All capacities are estimated using march demand which

CONCLUSION

It was possible incorporate to design building process aspects of resilience that can contribute to surrounded community to be prepared and recover after natural disaster. Following *passivhaus* standard, it was possible achieve a reduced energy annual demand which could be covered by renewable energies in-site produced, so school building can keep functioning through and after critical events maintaining a good thermal performance.

REFERENCES

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(2) MOP. 2013. TDRe: Términos de Referencia Estandarizados con Parámetros de Eficiencia Energética y Confort Ambiental. http://arquitectura.mop.cl/eficienciaenergetica/Paginas/default.aspx

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