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Article

Innovative and Sustainable Temporary Structures to Guarantee Emergency Basic Healthcare in Italy

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Abstract: In general, during emergencies, healthcare is provided by tents and temporary structures that do not consider the environmental and social impact of the structure as a first term, in favor of swift response. The resultant construction intended as a temporary solution often persists long-term. This paper aims to analyze an alternative and innovative modular structure designed as a transitory solution in emergency and everyday life. In the first part of the paper, the conceptual framework, and the preliminary design for the new approach to basic non-conventional sanitary spaces are described, by investigating the benefits of a safe space as a generator space for care services and community. In the second part, the technological requirements of the system, its energy efficiency, and environmental impact are analyzed.

Keywords: emergency buildings; sustainability; energy simulation

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1. Introduction

This paper aims to study the adaptation of a system designed as a healthcare center for destitute and irregular immigrants in Italy in other emergencies, such as flooding and earthquakes, in different regions of the country.

Nowadays climate change and geopolitics dynamics are spreading all over the world generating emergencies, forcing people to abandon their own houses and live in refugee camps or inadequate situations. To contrast these phenomena, countries are trying to address the challenges of designing emergency buildings, facing the requirement needed by the situation to guarantee acceptable living conditions as a matter of human rights.

There is a multitude of studies focusing on the use of modular construction as a response to emergencies. The literature review regarded an overview of the emergency models and experiences in past and recent studies. In the last twenty years, several strategies and innovations have been proposed to ensure the capacities of healthcare facilities during and after disasters [1].

Countries have tried to face the challenge of building emergency features capable of considering sustainability in their design. Examples are the refugee camps of Al-Azarq [2] working only with renewable energy and, generally speaking, the research is going in this direction also due to the reality that temporary solutions usually become a permanent house for the lifetime of people involved.

An emergency is defined [3] as a quick modification of the urban spaces to accommodate temporary settlements that should respond to the people's needs and can be derived from different causes: Middle East and Africa are known for their humanitarian emergencies, while the Global East and Caribbean for climate emergencies.

The Italian territory has been interested in emergencies such as earthquakes or flooding that have been solved by using primary emergency modules, such as tents and containers [4,5].

In recent times, COVID-19 represented a unique and urgent emergency that imposed the fast construction of temporary hospitals, a great challenge to the construction industry [6,7].

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According to the UNISDR report [8], Italy is one of the most affected countries in the world by natural catastrophes. The variety of the territory brings a multitude of aspects, including systemic and hydrogeological risks, and volcanic risks. Due to the humanitarian crisis in the Mediterranean areas, in the past decades, Italy has become a center of attraction for people seeking shelter from their situations.

2. Materials and Methods

The aim of this study is to define a modular adaptive model to fit basic healthcare for people who are not enrolled in the Italian National Health System. The main goal is to overcome the standard models, by proposing a new model able to diminish the weaknesses of the current sanitary models, to improve the social aspects, flexibility, energy efficiency, and thermal comfort of the occupants.

Differing from other models of sanitary emergency structures (first aid, COVID-19, etc.) the model proposes an applicable method throughout the Italian territory that adapts to the needs of every single context regarding migrants' and indigent people's assistance, by considering a long-term life (about 10 years) and the possibility to be used for other uses. The main steps of the research methodology are:

- Model definition. In the first part, the conceptual framework and the preliminary design for the non-conventional sanitary spaces are described, by investigating the benefits of a safe space as a generator space for care services and community.
- Technology definition. Then, the technological requirements of the system have been defined, by comparing the use of a panel structure to traditional structures (tents and shelters) in terms of sustainability, flexibility, and low-impact technologies.
- Energy simulations. Finally, the energy efficiency and environmental impact of the model are analyzed, using a model simulator (Energy Plus and Openstudio).

3. Model Analysis

Health is the result of our quality of life, which also includes the well-being dictated by the integration of an individual into society rather than residing on its margins.

The World Health Organization [9] talks about the health determinants referring to the social and economic environment, the physical environment, and the individual environment. The physical environment and the social support networks are considered the main causes of these three categories. The first one refers to safe houses, and communities, while the second one links health to families, friends, and community networks.

Creating spaces that offer only a medical response would be sufficient but not exhaustive, because it would not aim to implement the lifestyles of these individuals who, once the purely medical treatment is finished, would find themselves alone again.

For this reason, the importance of a space entirely dedicated to socialization is emphasized in the model, trying to create a space where schools and associations can support local communities.

3.1. Definition of the Prototype and Requirements

The concept of the emergency model develops simultaneously with the needs identified during the analyses of the healthcare facilities for destitute and undocumented immigrants. Indeed, the concept of the prototype is built on the idea of creating a social area in the spaces commonly known as the service-distributive and waiting rooms of the facilities, and that usually are considered less important in the building design processes.

The design principle starts from the idea of social aggregation spaces as connections, tipping over the reference guidelines in which corridors and waiting areas are junctions and crossing points.

The idea aims to create a sense of resilience among the users, who are usually people in difficult situations, suffering from loneliness. Referring to resilience, as defined by Hay A. et al. in planning

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resilient communities [10], the infrastructure shouldn't oppose the change, but manage and respond to the change, by supporting the society during its recovery.

The first analyses have been carried out with associations working in healthcare access for undocumented immigrants and the destitute. During the data collection to verify the importance of the additional social space, several interviews were conducted. All the interviewee associations confirm the need to have a social space outside the therapy. That is why the requirements of the model already consider psychological help as a private space in which those people can find support from a professional but also for external spaces[1].

As undocumented immigrants reside at the margins of society and rarely have the opportunity to interact with other individuals, also emergency victims need the same functional space where they can develop resiliency and create common feelings, spending time with people that can positively affect their mental health. This is why the common area is proposed by overtaking the traditional model of the corridor, instead, it is adapted all over the clinical spaces, giving them the chance to create a social network and also spend days with other associations and schools that are working on the territory to promote social inclusion and support.

As we are talking about healthcare situations, proximity issues are worth to be considered. During the designing process, the position of boxes will consider the interpersonal distance definition given by Hall [11] and will be designed differently, according to the needed levels of privacy.

Finally, the model is divided into two different components, defined by the concept's needs:

- The common space, which is more flexible and adaptable to the dimensions, fluxes, and shape of the lot;
- The box space, which are the proper modules supposed to provide the medical cures. The box organization can be divided into different medical offices, among which it is possible to have general practitioner offices, gynecologist offices, and psychological and psychiatric offices.

All the system is a modular construction, developed on two different systems: the platform and the box. In particular, the platform is associated with the common areas, more flexible and adaptable to the dimension and shape of the lot; while the box is defined as a less flexible structure, although it can be liberally moved on the directives of the platform.

1. [1] Interviews with the Private Association were conducted in 2022. Medical professionals were asked about above-cited topics. Private Association participating in the initiative were in the Emilia-Romagna region: Biavati Association of Bologna, Caritas of Ferrara, Caritas of Reggio Emilia, Sokos Association of Bologna, in Marche region: Caritas of Senigallia. Starting from December 2023, thanks to this association, to volunteer working in education for refugees, and Refuges Welcome, we are collecting questionnaires from refugees and undocumented immigrants which confirm the necessity of support from the community and psychological diseases caused by social status, violence, and loneliness.

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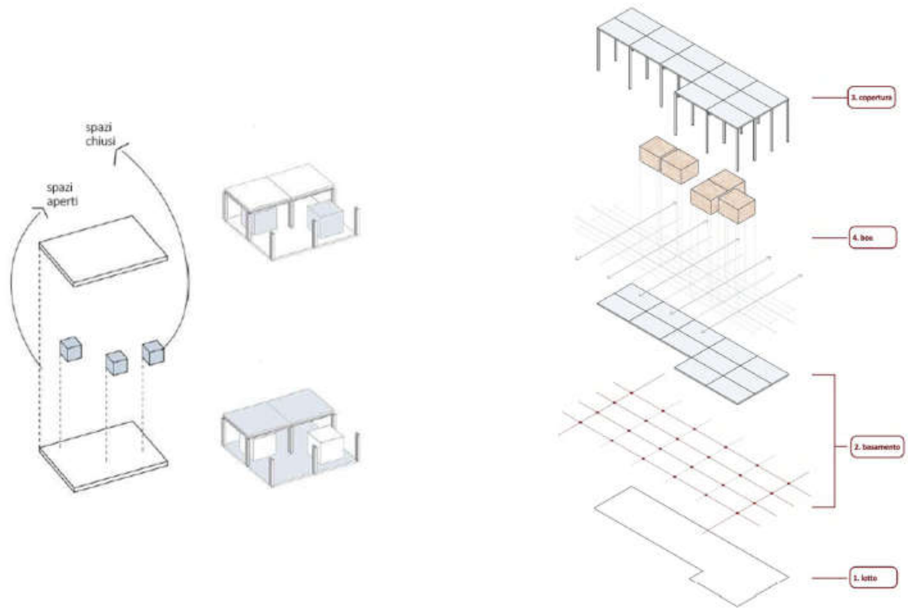

(**a**) (**b**)

Figure 1. The concept of the prototype is divided into Box and Platform. (**a**) 3D Visualize the functional separation between the box and the platform; (**b**) Description of the possible movement of the defined box spaces among the more-free-designing platform area.

To assess the model affordability, Table 1 compares traditional solutions, such as emergency tents and shelters, to the modular panel model proposed in this paper. In the table, we define the system of the prototype compared to the main emergency building solutions: to each solution, we assigned a mark, 1 is the minimum score that deviates the most from the assigned definition on the right, while 3 is the maximum score, indicating a closer alignment to the requirement defined on the left.

Sustainability and innovation consider different aspects: first, sustainability as energy efficiency and adaptability to renewable energy sources. On the other hand, the internal and psychological comfort of the users. Furthermore, considerations on flexibility are made. It concerns the adaptability to external contexts, the implementation of the system, and the composition and relation of internal functional spaces.

Finally, the speed of construction and the economic evaluation are considered, because due to the nature of emergencies, those structures are required to be assembled and function in the shortest time.

Emergency tents are waterproof and windproof structures. On the market are usually made of polyester materials, but in the literature, it is possible to find also examples in cotton and modacrylic. Cornaro et al. [12] and Lv T. et al. [13] have studied the implementation of this typology with PV technology and internal comfort, even if it is rare to find such solutions on the market. They have various ranges of dimensions, but the structure itself is inflexible. Moreover, the well-being of the users is compromised.

Shelters nowadays are the most used technology for temporary buildings. Currently, it's recognized as the most sustainable emergency solution due to its ease of implementation with facilities and renewable energy solutions, to become self-sufficient units. Although the solution is extremely standardized, for this reason, flexibility and customization of the spaces decrease, and used in significant urban areas can generate an alienating environment disregarding cultural and social norms. The speed of construction is optimal, but the shipping transportation can last a long time [14]. Also, the economic evaluation can be expensive compared to the other systems.

The panel construction is composed of sandwich panels, which can be customized, according to the requirements of the geographic area. Although each panel has a different function, the

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composition of the prefabricated sandwich panels is basically the same: insulating stone wool supported by metal C, which ensures the self-support of the panels and closed on both sides by OSB panels, treated from the inside to prevent the entry of steam and condensation. The energy efficiency and the internal comfort of the system need to be verified every time. On the other hand, it can be implemented alongside renewable systems, which are equally crucial, especially considering the complexity of the facilities system compared to the shelter system.

Despite the modularity of the system, the customization of the spaces can generate flexibility in the environment and can reflect a phycological-friendly environment for users.

It is an easily built and economic system that verifies the economic analyses due to the use of the most common materials according to the situation. Indeed, an economic evaluation of the system was made, reported in previous work [1].

Table 1. The table visually summarizes the comparison among emergency structures.

Table 1		**Emergency Tent**	**Shelter**	**Panels**
Sustainability	Energy efficiency	1	3	?
	Renewable implementation	2	3	2
	Indoor quality	1	3	?
Flexibility	Adaptability to external conditions	1	1	3
	Implementation and composition of the system	1	2	3
Construction	Speed of Construction	3	2	2
	Economic solutions	3	2	1

3.2. Simulation

This paper aims to study the energy efficiency of the system. Material choices are determined by economic evaluation and reparability on the market.

The box's walls and ceiling are made of OSB and mineral wool sandwich panels. Its structure is made of aluminum profiles, while the platform structure is built of stainless steel S275.

An additional system of box panels was adopted to compare the efficiency of a low-density material such as mineral wool with one high density such as wood fiber.

Across the platform, operable polycarbonate panels cater to users' needs, particularly during the winter months in the North of the country. Polycarbonate was selected for its safety in public places, where glass is not recommended due to its weight. Additionally, its lightweight nature aids in construction site efficiency, coupled with its advantageous price point.

The ground floor is made by using woodbeton panels, both for boxes and platform; while for the platform roof, sandwich panels are used, assembled as aluminum and XPS panels.

The modular structure of the platform is 5,70m*3,90m, while the box is 3,75m*3,75m. This prototype considers six platform modules and two box modules.

SketchUp and EnergyPlus have been utilized to conduct the simulation: the 3D model has been crafted using the EnergyPlus plug-in for SketchUp, delineating the two distinct spaces - the box and the platform - as separate thermal zones interchanging heat. A significant contrast lies in the presence of heating equipment solely within the box structure, while the platform does not provide plants as it is intended as a buffer space, and also to reduce maintenance costs. Additionally, cooling solutions have not been explored, aiming to scrutinize the system with minimal equipment configuration. In Table 2 the materials used in the simulation are described

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Table 2. Materials' properties used during the simulation.

Table 2	s [m]	λ [W/mK]	ϱ [kg/m^3]	C_s [J/KgK]
OSB	0,012	0,10	530	1000
Mineral Wool	0,08	0,034	80	1000
Wood Fiber	0,08	0,037	110	2100
XPS	0,12	0,036	32	1700
Woodbeton	0,40	0,26	1350	1880
Polycarbonate	0,06	0,21	200	1170
Aluminum	0,01	172	2800	962
S275	0,21	45	7850	502

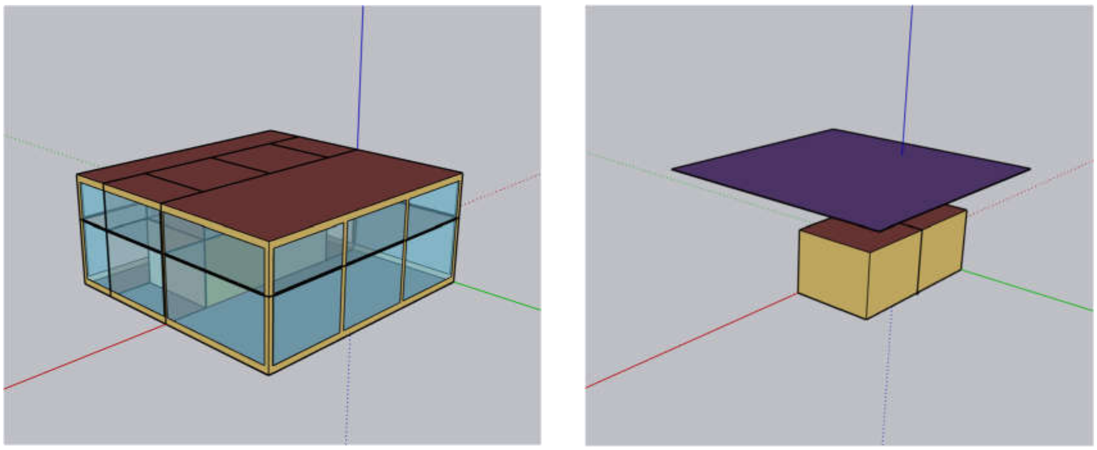
Various approaches have been examined to assess the thermal significance of the system: the simulations have been run in two extreme Italian climate conditions all over the year, the Bolzano (North- cold weather) and Palermo (South- hot weather) areas (Table 3).

Table 3. Properties of the case studied sites.

Table 3	Bolzano	Palermo
Weather file	Bolzano - ITA IGDG WMO#=160200	PALERMO - ITA IWEC Data WMO#=164050
Latitude	46,47	38,18
Longitude	11,33	13,10
Elevation	791 ft	112 ft

In Palermo, to avoid the overheating problem, a scenario considers the opening of the windows in the platform. Moreover, in both north and south locations, a simulation was made by increasing the polycarbonate performance, using double panels within the air gap.

Finally, in the latest simulation, the boxes were considered as the sole thermal zone, by removing the polycarbonate panes and considering the roof a shading control apparatus. This enables a comparative analysis with the results obtained when the platform was treated as a buffer zone.



(**a**) (**b**)

Figure 2. Sketch-Up model used in the Openstudio simulations. (**a**) The first option considers the box and platform as two different thermal zones communicating with each other. To do that, the model was created by dividing the areas into extruded-based-shaped rectangle spaces. All the walls in the same thermal zone generated during the extrusion of the model were treated as air walls; (**b**)

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The second option considers the platform system as a shading device by removing the external polycarbonate panels.

3. Results

In this study, several simulations are compared with the main aim to assess the efficiency of the model, by considering two climatic areas (Bolzano – north Italy and Palermo south Italy) by using different technical solutions. The software Openstudio calculates the number of hours at a certain temperature over the period of one year.

This was helpful for examining different design hypothesis to improve thermal comfort and the global energy efficiency of the system.

3.1. Simulation Results – Bolzano Area

3.1.1. Bolzano – Simulation 1

In Table 4 the values of the simulation run in Bolzano are presented. In this hypothesis, the box is insulated by mineral wool and the platform is built with one layer of polycarbonate panels. The mean relative humidity registered in the box is 14.2%, while in the platform is 22.7%. The mean temperature registered in the box is 68.9 °F (20 °C), while in the platform is 61.4 °F (16,3 °C).

In the table below it is possible to read the different temperature ranges registered for each thermal zone.

Table 4. Bolzano site. Box: mineral wool insulation panels. Platform: one layer polycarbonate panels. Hours spent in each temperature range in one year.

Table 4	< 56 [F]	56-61 [F]	61-66 [F]	66-68 [F]	68-70 [F]	70-72 [F]	72-74 [F]	74-76 [F]	76-78 [F]	78-83 [F]	83-88 [F]	≥ 8 [F]
TZ-BOX	0	1874	845	874	447	1818	707	610	868	493	216	8
TZ-PLATFORM	3556	601	499	631	305	298	278	288	515	470	385	934

3.1.2. Bolzano – Simulation 2

In this second simulation, the use of a different insulation has been considered. The table represents the values obtained in the simulation run in Bolzano, in which the box is insulated by wooden fiber and the platform is built with one layer of polycarbonate panels. The mean relative humidity registered in the box is 14.1%, while in the platform is 22.7%. The mean temperature registered in the box is 69 °F (20,5 °C), while in the platform is 61.4 °F (16,3 °C).

In the table below it is possible to read the different temperature ranges registered for each thermal zone.

Table 5. Bolzano site. Box: wooden fiber insulation panels. Platform: one layer polycarbonate panels. Hours spent in each temperature range in one year.

Table 5	< 56 [F]	56-61 [F]	61-66 [F]	66-68 [F]	68-70 [F]	70-72 [F]	72-74 [F]	74-76 [F]	76-78 [F]	78-83 [F]	83-88 [F]	≥ 88 [F]
TZ-BOX	0	1804	861	862	442	1798	711	639	872	521	244	6
TZ-PLATFORM	3554	594	500	618	321	303	278	286	526	479	379	992

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3.1.3. Bolzano – Simulation 3

In this simulation, the box is insulated by mineral wool and the thermal properties of the platform are improved, by considering two layers of polycarbonate panels separated by a closed air gap.

The mean relative humidity registered in the box is 14.5%, while in the platform is 22.6%. The mean temperature registered in the box is 68 °F (20 °C), while in the platform is 60.8 °F (16 °C).

In the table below it is possible to read the different temperature ranges registered for each thermal zone.

Table 6. Bolzano site. Box: mineral wool insulation panels. Platform: double layer polycarbonate panels and closed air gap. Hours spent in each temperature range in one year.

Table 6	< 56 [F]	56-61 [F]	61-66 [F]	66-68 [F]	68-70 [F]	70-72 [F]	72-74 [F]	74-76 [F]	76-78 [F]	78-83 [F]	83-88 [F]	≥ 88 [F]
TZ-BOX	0	1955	915	959	578	2079	737	544	607	359	27	0
TZ-PLATFORM	3518	654	542	624	338	367	316	326	582	483	419	591

3.2. Simulation Results – Palermo Area

3.2.1. Palermo – Simulation 1

The same simulations have been done in a South area of Italy. The table represents the values obtained in the simulation run in Palermo. The box is insulated by mineral wool and the platform is built with one layer of polycarbonate panels.

The mean relative humidity registered in the box is 37.5%, while in the platform is 34.4%. The mean temperature registered in the box is 68.2 °F (20.1 °C), while in the platform is 72.9 °F (22,7 °C).

In the table below it is possible to read the different temperature ranges registered for each thermal zone.

Table 7. Palermo site. Box: mineral wool insulation panels. Platform: one layer polycarbonate panels. Hours spent in each temperature range in one year.

Table 7	< 56 [F]	56-61 [F]	61-66 [F]	66-68 [F]	68-70 [F]	70-72 [F]	72-74 [F]	74-76 [F]	76-78 [F]	78-83 [F]	83-88 [F]	≥ 88 [F]
TZ-BOX	0	0	275	1223	661	1364	534	512	1059	1241	1295	596
TZ-PLATFORM	157	1054	765	693	308	336	359	311	685	786	767	2539

3.2.2. Palermo – Simulation 2

This simulation runs a hypothesis to reduce hot air in the buffer area, by considering polycarbonate panels operable and open during the simulation for the 50% of their dimension. The box is insulated by mineral wool and the platform is built with one layer of polycarbonate panels.

The mean relative humidity registered in the box is 31.9%, while in the platform is 57.7%. The mean temperature registered in the box is 75.3 °F (23 °C), while in the platform is 73.6 °F (23,1 °C). In the table below it is possible to read the different temperature ranges registered for each thermal zone.

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Table 8. Palermo site. Box: mineral wool insulation panels. Platform: one layer polycarbonate panels and openable windows. Hours spent in each temperature range in one year.

Table 8	< 56 [*F*]	56-61 [*F*]	61-66 [*F*]	66-68 [*F*]	68-70 [*F*]	70-72 [*F*]	72-74 [*F*]	74-76 [*F*]	76-78 [*F*]	78-83 [*F*]	83-88 [*F*]	≥ 88 [*F*]
TZ-BOX	0	0	282	1247	828	1768	1017	753	1021	769	739	336
TZ-PLATFORM	157	1059	794	860	637	700	582	516	1243	683	289	1240

3.2.3. Palermo – Simulation 3

The same simulation, with polycarbonate panels of the platform open during the simulation for 50% of their dimension table, has been done by considering wooden fiber panels in the box.

The mean relative humidity registered in the box is 31.6%, while in the platform is 58.1%. The mean temperature registered in the box is 73.7 °F (23,2 °C), while in the platform is 73.6 °F (23,1 °C).

In the table below it is possible to read the different temperature ranges registered for each thermal zone.

Table 8. Palermo site. Box: wooden fiber insulation panels. Platform: one layer polycarbonate panels and openable windows. Hours spent in each temperature range in one year.

Table 8	< 56 [*F*]	56-61 [*F*]	61-66 [*F*]	66-68 [*F*]	68-70 [*F*]	70-72 [*F*]	72-74 [*F*]	74-76 [*F*]	76-78 [*F*]	78-83 [*F*]	83-88 [*F*]	≥ 88 [*F*]
TZ-BOX	0	0	141	1222	896	1775	1055	783	975	758	770	385
TZ-PLATFORM	147	1043	790	881	641	695	600	530	1240	672	292	1229

3.2.4. Palermo – Simulation 4

The last simulation in Palermo considers the box insulated by mineral wool and the platform built with two layers of polycarbonate panels. <as in the simulation in Bolzano, the polycarbonate panels are not openable, and the air cavity is closed, to assess the impact of the air gap between the panels to increase the thermal mass.

The mean relative humidity registered in the box is 31.9%, while in the platform is 31.7%. The mean temperature registered in the box is 73.5 °F (23 °C), while in the platform is 75.8 °F (24.3 °C).

In the table below it is possible to read the different temperature ranges registered for each thermal zone.

Table 9. Palermo site. Box: mineral wool insulation panels. Platform: two layers polycarbonate panels and closed air gap. Hours spent in each temperature range in one year.

Table 9	< 56 [*F*]	56-61 [*F*]	61-66 [*F*]	66-68 [*F*]	68-70 [*F*]	70-72 [*F*]	72-74 [*F*]	74-76 [*F*]	76-78 [*F*]	78-83 [*F*]	83-88 [*F*]	≥ 88 [*F*]
TZ-BOX	0	0	431	1526	735	1439	548	554	1211	1475	822	19
TZ-PLATFORM	127	1134	844	755	350	386	377	351	733	827	802	2074

3.1. Simulation Results – No Platform as Thermal Zone

The last simulation, run for both sites, considers that the platform is not intended as a thermal zone but as a shadow device. This implies that the polycarbonate panels are not installed.

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The mean relative humidity registered in Bolzano is 15.3%, and the mean temperature is 66.4 °F (19.1°C). On the other hand, the mean relative humidity in Palermo is 35.2%, and the mean temperature is 70.5°F (21.4°C).

In the table below it is possible to read the different temperature ranges registered for each site.

Table 10. Bolzano and Palermo site. Box: mineral wool insulation panels. Platform: no polycarbonate panels (open platform). Hours spent in each temperature range in one year.

Table 10	< 56 [F]	56-61 [F]	61-66 [F]	66-68 [F]	68-70 [F]	70-72 [F]	72-74 [F]	74-76 [F]	76-78 [F]	78-83 [F]	83-88 [F]	≥ 88 [F]
BOLZANO	0	2336	933	1359	570	2478	431	284	263	106	0	0
PALERMO	0	331	1157	1336	706	1797	666	679	1284	740	64	0

4. Discussion

Considering the system does not provide a cooling system and only the box area is supposed provided by the heating system, the mean temperature is an acceptable range for almost every simulation.

However, consideration should be on the annual range temperature. As expected, summer overheating and winter cold can affect the whole system.

It is interesting to notice that even though the simulations have been made considering insulating materials with different densities – mineral wool and wooden fiber -the annual variations are not so relevant in both climatic zones.

The buffer zone of the platform was designed without any heating system- to reduce utilities-only as repair for people. In the North site, the results show that the platform area spent almost 3550 hours in temperatures around 56 °F (13°C) which is a good result. However, a slight improvement is registered when we use double polycarbonate panels.

On the other hand, in the Palermo southern area, where the temperature is very high in summer, the risk of overheating is registered. In Table 7, the number of hours in which the temperature exceeds 88 F (32°C) is 2539.

Then, it is possible to read from the simulations, that very simple actions - like opening the window or increasing the mass of the polycarbonate - improve the results. In particular, operable windows help reduce overheating over 88°F (31°C) from 2539 hours to 1240 hours (Table 8). Also, in the last option (Table 10), where the platform is open and considered as a shading tool for the boxes, the impact of this system on the boxes can be seen, as the number of heating hours (above 83 degrees) is considerably reduced.

By the way, the use of a closed platform is positive in the Bolzano area (cold climatic area), where the presence of a buffer zone protects the internal structures and improves the thermal exchanges. By comparing the results in Table 4 it can be seen that the hours at 56-61°F (13-16°C) is 1874 when the platform is closed (Table 4) and 2336 in the case of removing the external panels (Table 10).

On the other hand, in Palermo (hot climate), we find that installing the system without panels results in increased air circulation, which reduces extreme overheating to 83-88°F (28-31 °C) from 1295 hours (739 if operable), see Table 7, to 64 hours and overheating above 88°F (31°C) from 596 hours (336 if operable) to 0 hours, as seen in Table 10.

5. Conclusions

This study investigates the energy performance of a modular box system that can be used for healthcare facilities in response to an urgent phenomenon regarding people who need care without being regular citizens.

Based on the preliminary analyses of existing models and structures operating in Italy, a new modular concept has been designed to address the issue of assistance in several situations, from emergency management to ordinary (operating in synergy with existent contexts) situations. By taking into account the psychological implications of the users, open areas are entirely dedicated to

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the humanization of services for indigent people who need a place to spend the day, in this sense the model overcomes the traditional concept of emergency structure.

As the economy of the project is fundamental, as well as the ease of assembly, the prototype has been created to meet the requirements of flexibility and sustainability.

Further studies should consider the implementation with more performing materials, considering the economic scenario not as the priority, or can also consider the application of a facilities system all around the model.

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