HARMONISATION OF PROCEDURES AND POST-DISASTER SETTLEMENT PROPOSAL IN PIEDMONT

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Abstract

The paper discusses the methods for the planning of temporary accommodation operations following natural emergencies in a diversified territorial setting (Piedmont, Italy). The research was carried out by Turin Polytechnic and the Piedmont Region and focuses on the prevention aspects. The output of the research is a pilot project with proposed constructive system (residential/productive units) for use in two towns in Piedmont, Pinerolo (Torino) and Castelmagno (CN). It emphasises that the application of preventive measures requires a review of the methods applied in accordance with the way in which the territory is inhabited and the local context, with the use of appropriate technology and spatial distribution that takes the new user requirements into account.

Keywords: Seismic risk; Civil protection; Temporary emergency accommodation Technologies; Requirements; Residential/production units

INTRODUCTION

Preventive measures make up the fundamental basis of civil protection operations. Programming with a view to reducing and mitigating risk has always been regarded as the reference policy and philosophy, whose application has frequently come into conflict with territorial and town planning approaches that dedicate insufficient attention to environmental safety. Civil protection has therefore had to tackle a number of critical points in its attempt to achieve its ambitious aim of transforming an emergency into a routine event (Bocchi, 1985). This approach, adopted within models based on the theory of risk, has made it possible to draw a distinction between *programming* and *planning*.

While risk is a function of the probability of occurrence and the vulnerability of the people (Catarinussi, Pelanda, 1981) and property exposed to an event, the role

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of civil protection by its very nature is damage limitation. Vulnerability, which can be broken down into *susceptibility and resilience*, therefore takes on a strategic connotation. S*usceptibility* expresses the fragility of the elements exposed to the risk and may be quantified. *Resilience* takes into account the various fragility factors and enables us to plan and dimension the response that civil protection has to provide. The planning of the response requires the availability of a detailed list of the material resources necessary to deal with the events. This preventive activity is significant and of a determining nature not only with a view to providing and managing resources and materials, but also becomes essential when areas have to be set up for the shelter of the population.

Experiences of recent years with complex events requiring a response in terms of accommodation have emphasised the need to review the overall sociological, environmental and technological nature of emergency accommodation. We should recall the impact and shortcomings which have emerged from recent aid operations in which widespread use was made of obsolete accommodation structures that are unable to satisfy 'evolved' requirements. Methods of prevention in this area therefore have to be reviewed on the basis of the historic stratification of ways of living, as well as the new developments in user requirements. For this reason, there are a number of questions that have to be answered if we are to identify a new approach and a new planning strategy.

Can the building standards currently adopted in emergency situations apply in different environmental and cultural contexts? (Foti, 1989)

Social and functional models consolidate rules and customs. Are the prefabricated buildings used in emergencies able to guarantee that continuous, often unexpected transformations of behaviour will be able to take place in adequate and suitable physical spaces? (Mango, 1984)
Are construction and plant technologies capable of offering service levels compatible with the immediate response capability required of the civil protection forces?

DINSE and a number of civil protection experts from the Piedmont Region have set up a temporary emergency accommodation research group to consider the various seismic risk situations and draw up an emergency accommodation plan that will be able to respond to new accommodation requirements, while at the same time harmonising the public solidarity response and guaranteeing the economic sustainability of the operations.

THE AREA OF APPLICATION

Many disastrous events, such as flooding and avalanches, remain fresh in the memory of the population of Piedmont. By comparison with these, the risk of earthquake may appear to be of secondary importance.

A rational acknowledgement of the real situation has however brought to light that there have been earthquakes in Piedmont in relatively recent times. From 1276 to the present time, no less than 23 'powerful earthquakes' (Guidoboni *et al.*, 1995) have been documented by the National Institute of Geophysics with epicentres in the region or surrounding areas[3].In the recent review of the chart of seismic risks in the region, the high level of monitoring of terrestrial movement has shown that the territory potentially at risk is greater than was originally suspected. 38 settlements are currently subject to earthquake risk level 2 and another 154 are at level 3, while 1000 are classified as low risk areas. In percentage terms, the area is limited, and is concentrated above all in the south western piedmont and mountain zone of the Maritime Alps and the Cozie and Graie ranges, where the movements of the earth's plates are however of low intensity (maximum magnitude 3.2), but continuous and relatively regular[4]. On the basis of the above, we selected Pinerolo in the province of Turin and Castelmagno in the province of Cuneo as specific case studies for the testing of the temporary structure project.

The demographic, morphological, environmental and socioeconomic features of these two locations are radically different. Pinerolo is a medium sized town (population 35,331) in the piedmont zone with a temperate climate of hot summers and cold winters, a high density of population, a metropolitan style social structure and an important architectural heritage, located in a zone at earthquake risk 2, while Castelmagno is a small mountain village with a population of 163 spread over a wide area, located at altitudes ranging from 800 to 2,000 metres above sea level. It has recently been revitalised by the official recognition of the locally produced cheese, and is in a zone at earthquake risk 3.

THE PROJECT PHILOSOPHY

The fundamental objective of the operation is to set up an accommodation module to be applied in emergency situations. The formal and technological

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[3] Particularly significant are the two 1808 episodes (2nd and 16th April), when a force 8 movement on the Mercalli scale with epicentre in Luserna San Giovanni struck the Pinerolo area, with around 15,000 settlement shocks that continued for several months. There were 2 victims and many injured, but the damage was enormous and the social implications were severe for the entire area around the town of Pinerolo, here the risk levels are still high and classified as level 2, the highest in the region. See GUIDOBONI, E., *op.cit*.

[4] See *www.ingrm.it.* The *recent earthquakes* entry lists all the episodes that occurred in 2002 and 2003. From this information, we can see that the plate movements affect the Maritime Alps, Cozie and Graie zone virtually every month.

aspects are based on past experience in this sector (Donato,1983), and the aim is to offer a significant quality upgrade with respect to the proposals currently available on the market, which will ensure that the structures are compatible with the different situations that could emerge in the earthquake risk areas of Piedmont (EDIL-PRO,1983).

More specifically, in a region with a particularly delicate mountain environment, it is important to ensure that the solutions are valid for zones of this kind, while at the same time ensuring a uniformity of construction elements, assembly and erection methods, to enable the protection organisation to simplify the operations in a highly complex situation as far as this is possible.

In the event of catastrophes, the emergency accommodation installed has to take into account not only the residential problem, but also the continuation of a series of productive operations that make up the backbone of the local resources. Consequently, one of the objectives of this proposal is to ensure that the structures can adapt to non-residential requirements.

The general objectives can therefore be summed up as follows:

- maintenance of the levels of quality of life by providing spaces in which the traditional ways of living and working can continue,
- adaptability to settlements of different sizes,
- adaptability to different functions,
- adaptability to the environmental context through different structural solutions,
- focus on the control of thermal flows from winter to summer and vice versa, by separating the technological subsystems and differentiating the services provided,
- structures which are easy to assembly, dismantle and store, by ensuring that the pre-assembled module is of compact volumes,
- dry assembly methods,
- use of technical elements based on existing production and available on the Italian market,
- interchangeable technological subsystems, with particular reference to plant and equipment or furnishings,
- minimum impact on the site.

General principles for the selection of the areas

The first stage of the project involves the selection and organisation of the areas in which the emergency settlements are to be built. The variable nature of the environmental and social situations makes it necessary to assess each single case and the specific responses to it (Bologna, 2005). However, we have taken

into account a number of fundamental requirements that have influenced the selection of the areas and the structuring proposals for these (Zaffagnini, 1981).

For the selection of the area:

- absence of hydrogeological risks,
- dimensions suitable to achieve a good level of urban organization without creating excessive congestion,
- close to the historic settlement
- close to infrastructures.

For the organisation of the area:

- grouping into settlement subsystems in which neighbours are familiar with each other,
- grouping of the outside spaces into private, semi-private and collective areas,
- differentiation of the settlements, with service structures and areas in which local businesses can continue to operate.

Specific criteria

Pinerolo (TO)

In accordance with the terms of article 15 of law 225/92, in December 2002 a Civil Protection Plan for Aid in the Event of Natural or Man-made Catastrophes was drawn up for Pinerolo, in which 7 muster areas were identified for use in the various stages in the evolution of the emergency (holding, recovery and assembly, helicopter landing pads and areas for the accumulation of rubble).

These are all on flat ground. Some are near the town centre, while others are on the outskirts, in diametrically opposite positions with respect to the urban mass. Among these, the local government has indicated two which it believes are particularly suitable as emergency accommodation areas, with dimensions in proportion to the town's population.

The final selection of Piazza d'Armi, currently used as a trade fair, circus and equestrian event area, is the result of a comparison of various factors, of which the following were of a determining nature:

- the absence of hydrogeological risk, as confirmed by the National Cartographic Gateway[5],
- the dimensions of approximately 26,400 m^2 (see table 1). By applying the National Civil Protection guidelines[6], it will be possible to obtain a settlement

[5] The National Cartographic Gateway (www.atlanteitaliano.it) was set up following the agreement between the state and the regions of 12th October 2000, and currently contains the hydrogeological risk charts.

capable of housing 200 people, with good levels of urban organization without creating overcrowding,

- the position near the town centre, where there are medium levels of congestion and strong links with the historic and more recent built-up areas,
- the infrastructures. Two roads, Strada Fenestrelle and Via Don Minzoni, run along the edge of the area, the helicopter landing pad is nearby, there are water and electricity supplies and full connections to the sewage network can be easily made.

Table 1. Pinerolo (TO): dimensions in accordance with ministerial guidelines

AREA	**m^2**	**%**
Overall (SC)	26400	100%
Common green areas	9240	35%
Asphalted (B)	5280	20%
Gross residential area (SLR)	7920	30%
Services (S)	3960	15%
Gross area (SL)	17160	

Castelmagno (CN)

This area occupies part of the space indicated by the local government in the civil protection plan as a helicopter landing zone. Near the Sanctuary of San Magno (1800 m above sea level), this zone is currently used as a car park during the tourist season.

It is regarded as suitable because:

- there are no hydrogeological restrictions,
- the presence of the Sanctuary means that the area is connected to the road and service network,
- on the basis of National Civil Protection guidelines, 17 structures can be built on the site, to house 34 people, with 3 units to be dedicated to cheese production and 3 for common services (shops, first aid posts, etc),
- the presence of the Sanctuary also creates a planning challenge, as the situation is delicate not only in environmental terms but also because of the presence of this historic religious site,
- as the area in which the emergency structures are concentrated, all requirements are catered for, Given the history of territorial settlement in the Castelmagno area, further constructions will be required in the livestock and pasture zones.

[6] Italian Prime Minister's Office, Department of Civil Protection.

Table 2. Castelmagno (CN): dimensions in accordance with ministerial guidelines

AREA	m^2	%
Overall (SC)	5400	100%
Common green areas	1890	35%
Asphalted (B)	1080	20%
Gross residential area (SLR)	1350	25%
Gross production area (SLP)	270	5%
Services (S)	810	15%
Gross area (SL)	3510	

General plan for the layout of the areas

Pinerolo (TO)

The area will be mainly used for residential purposes, but provision will also be made for the church and markets, which will be at the service of the entire population. The layout will be based on the mediaeval plan (Casalis,1833), with the church in a central position, surrounded by the markets, an arrangement that will be familiar to the community.

The *accommodation units,* consisting of the dwelling zone itself and the entrance, car parks and the common areas in which a number of outdoor activities may take place – eating, agricultural and other manual tasks, storage, and so on – are based on groups of 18, of varying capacities, which make *neighbourhood units,* with common parking and social areas for the users of the modules. These small urban nuclei surrounding a central courtyard create a suitable balance between the public and private, increase a sense of belonging and encourage the development of solidarity. The presence of family groups of different sizes and types of interpersonal relationships should further encourage exchanges and cooperation among the generations.

The 3 neighbourhood units make up the entire district, and are laid out for ease of movement of pedestrians and vehicles and in such a way that the residents can easily recognise the various residential units and their relation with the collective spaces.

In this way, spaces are hierarchized in private space (“living unit”), semi-private space (“neighbourhood”), public space (church, open-air market, streets for vehicles and pedestrian).

Castelmagno (CN)

The emergency structures in Castelmagno have to take into account the continuation of cheese production in the area, which takes place in the vicinity of the pastures.

The emergency structures will therefore cover an area smaller than the overall size the location permits, with 5 residential units (4 with two rooms and 1 with four, housing 14 people), in whose vicinity a further 3 modules for cheese production and 3 service units will be erected.

The service structures will take into account the presence of the Sanctuary and the tourists it traditionally attracts during the summer.
The structures will be installed in such a way as to blend into the natural environment and reduce their impact to the minimum.

Table 3. Pinerolo (TO), Castelmagno (CN): gross residential area and number of inhabitants housed

PROPOSED AREAS	**Pinerolo (TO)**	**Castelmagno (CN)**
Total SLR (m^2)	**7920**	**1350**
SLR/inhabitant (m^2/inhabitant)	**40**	**40**
No. of inhabitants (SLRtot/SLRab)	**200**	**34**
SC/Ab (m^2/inhabitant)	**133**	**159**

Table 4. Pinerolo (TO), Castelmagno (CN): total potential number of inhabitants divided up by residential nuclei

NUCLEI	**%**	**Pinerolo (TO)**		**Castelmagno (CN)**	
		Inhabitants	**No. of nuclei**	**Inhabitants**	**No. of nuclei**
Total nuclei[7]	100%	**200**	**55**	**14**	**5**
2 persons U.A. B.	12,5%	**26**	**13**	**8**	**4**
4 persons U.A. T.	75%	**150**	**38**		**0**
6 persons U.A. Q.	12,5%	**24**	**4**	**6**	**1**

[7] U.A. B.: two room accommodation units, U.A. T.: three room accommodation units, U.A. Q.: four room accommodation units, U.A. P.: production unit

The module and the residential/production units

The size of the module is determined by comparing the analyses of residential constructions for special uses[8], the existing structures, the transport situation and the adaptation of spaces to the requirements of the users[9].

On this basis, the standard area is 17 m^2 per inhabitant[10] and the module size is 34 m^2 (480 x 720 cm). Consequently, the smallest residential unit making up a module is designed for 2 users.

While aware that some nuclei consist of a single individual, we did not take this fact into account, partly because a single individual requires substantially the same space as two, given that the services and minimum furnishings must in any case be guaranteed.

For nuclei of more than 2 persons, the module will be doubled up or tripled to house 4 or 6 units respectively.

Because of the composition of the family groups in the areas selected, there is no need for larger residential modules. The solution proposed will however be able to adapt to any exceptions by simply adding on extra modules.

The production structure at Castelmagno is a single module whose dimensions are compatible with the cheese making operations that take place there.

Table 5. Dimensions of the settlements (net residential area)

Residential units	**Users**	**Modules**	**M^2**
U.A. B.	Up to 2	1	**34,5**
U.A.T.	3 to 4	2	**69**
U.A. Q.	5 to 6	3	**104**
U.A. P.		1	**34,5**

As far as the technology adopted allows, each residential unit will provide the minimum space necessary for the furniture and fittings required by the users. For this purpose, a specific planning schedule has been prepared for each type of unit (see tables 7 and 8).

[8] WE have taken hotel and student accommodation, units for temporary site workers and accommodation for post-catastrophe emergency workers.
[9] The net residential area per inhabitant various from 8 m^2 (site containers) to 18 m^2 for student residences. The maximum overall dimensions of a land transport vehicle are 700x240 cm.
[10] The net residential area is defined as the square metres of residential structure per inhabitant. The gross residential area also includes private green spaces and the private parking areas.

Table 6: residential units and the space provided

Residential unit	Unit of space	Residential unit	Unit of space
U.A.B. two rooms	U.S. B01: bedroom	U.A.Q. four rooms	U.S. Q01: bedroom 1
	U.S. B03: bathroom		U.S. Q02: bedroom 2
	U.S.B02: kitchen/living room		U.S. Q03: bedroom 3
			U.S. Q04: kitchen/living room
			U.S. Q05: bathroom
			U.S. Q06: bathroom
U.A.T. three rooms	U.S. T01: bedroom 1	U.A.P. production	U.S. P01: production
	U.S. T02: bedroom 2		U.S. P02: sales
	U.S. T03: kitchen/living room		U.S. P03: maturing area
	U.S. T04: bathroom		U.S. P04: bathroom

The technology was chosen following a comparison of the products available on the market, which we assessed on the basis of the social, cultural and environmental requirements of the project areas (Campioli, 1993).

The base module dimensions are 240 cm, which is also the size of the structural base, the openings of the door and window frames and the sub-multiple of the vertical panels. In this way, we obtain net dimensions for the base modules of 480x720 cm, which make them easy to handle and transport while limiting the number of component parts in the system. In non-emergency periods, the system components can be easily stored in the regional Civil Protection warehouses located throughout Piedmont. The openings are on the longer sides, diagonally opposite to each other, and one of these is also the access door. In this way, the bedrooms also have large windows. In each room, the equivalent of 1/8 of the area is taken up by ventilation and natural lighting space.

The bedroom and living areas are kept separate from each other. The kitchen-living room area is entered directly from the outside by a 3-step stairway, which can be replaced by a ramp in the disabled access version. The attic is inclined and open to all the rooms, and contains the bathroom area.

By combining a number of modules, accommodation for larger groups can be obtained. Accommodation units of this size have two entrance doors, for ease of access.
The system is assembled on a prefabricated basis, and can be easily erected by non-specialist workers or the end users themselves. The simplicity of the assembly and dismantling operations is based among other factors on the reduction to the minimum of the components parts of the system.

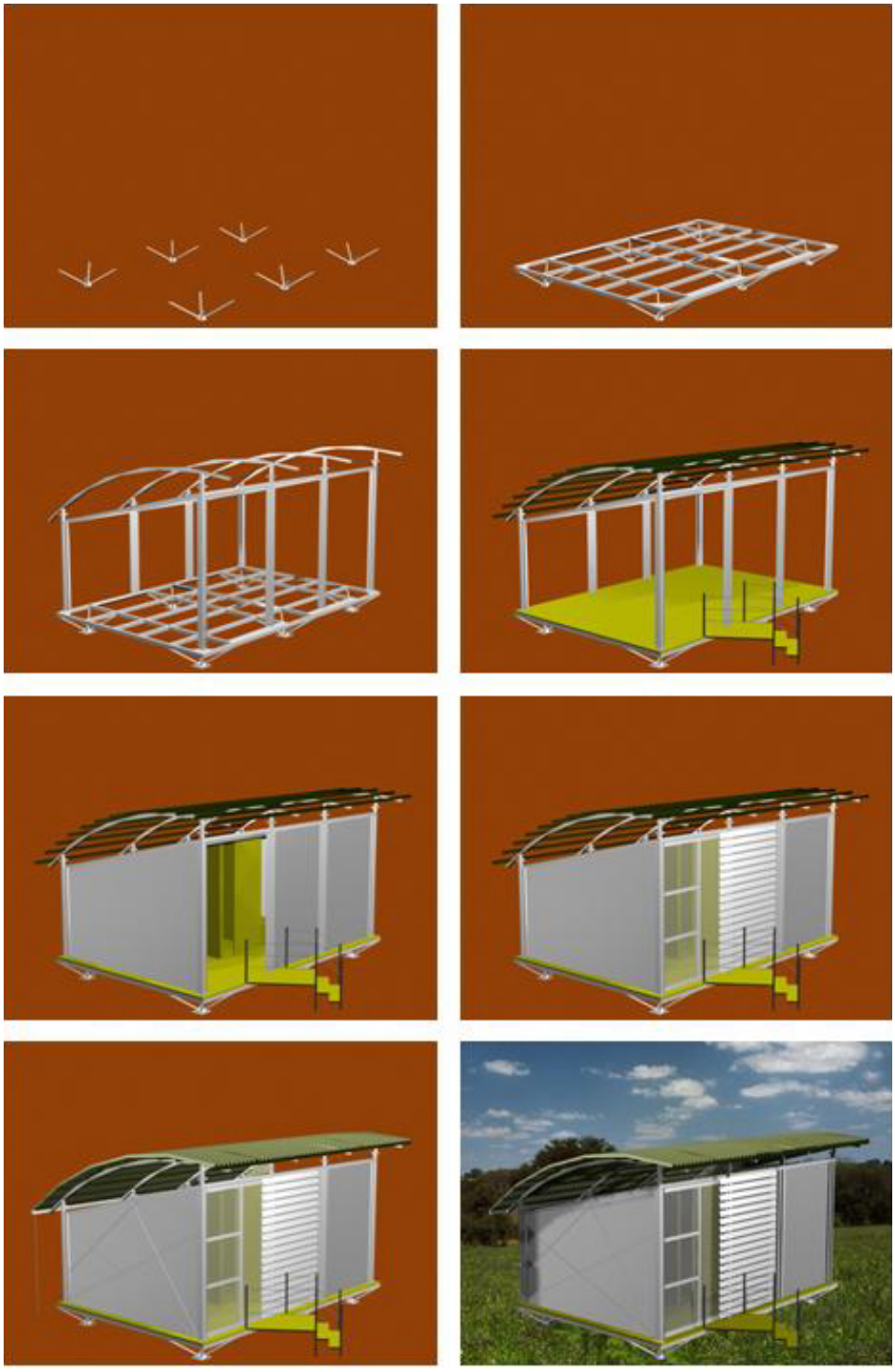

Figure 1: assembly of the base residential unit

Table 7 Two roomed unit: planning analysis schedule

Two roomed unit	**U.S. B**		
Bedroom	**U.S. B01**		
Standard area	**14 m^2**		
Users	**2**		
Activities	Single individual	With others	At the same time as other activities
Sleeping			
Washing			
Cooking			
Eating			
Study			
Communication			
Personal leisure time			
Collective leisure time			
Furnishings			
Bed	1		
Desk 120x80 cm	1		
Wardrobe	2		
Chair	2		
Bedside cabinet	2		
Bookshelves	1		
Bedside light	2		
Standard lamp	1		
Supplies			
Electricity			
Telephone			
Fire fighting terminal			
Drainage			
Extractors			

CONCLUSION

Experience built up so far has enabled us to assess the problems relating to temporary accommodation and propose new spatial models based on a careful planning analysis and technological solutions geared towards reducing the quantity of elements necessary, ease of transport and assembly, and forms that will blend in with the environmental nature of the site while at the same time guaranteeing maximum possible levels of comfort. However, a number of technological problems remain, especially with regard to the adaptation of areas which are not entirely suitable for settlements of this kind and which have not yet been taken into consideration in the local civil protection plans, and the installation of equipment to ensure self-sufficiency in terms of service supplies. It is only when these problems have been overcome that it will be possible to give an adequate response to the requirements of the single users in terms of environmental and practical living quality at individual and collective levels, with a view to guaranteeing acceptable standards of economic sustainability.

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