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CHANGING HABIT': A LOW IMPACT SYSTEM FOR TEMPORARY CONSTRUCTIONS

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ABSTRACT

The work starts from a study whose aim is the interpretation of the idea of temporary constructions, choosing to assume and to confront two approaches: constructions for programmable events and constructions for emergency situations. Operating in the field of both these aspects, the aim is to develop a project that excludes the idea of a completely defined module (which implies a huge waste of resources) choosing instead to develop a system with changing and adaptable configurations. The concept phase brings to the design of an assembly kit composed of a limited number of simple elements, and that, considering the whole life cycle, is characterized by low costs, reversibility, recycling or reuse of the entire structure or of some of its elements. Finally, the project, called Changing Habit', consists basically of a two-dimensional mobile frame, formed by bars and connections: thanks to few linear elements characterized by small size, it is possible to obtain a structure that is replaceable into different kinds of spaces and that can assume multiple configurations. This structure is also characterized by the development along a longitudinal direction, by the use of portals as basic modular element, and by the movement of its own constitutive elements to achieve different configurations.

The aim is to achieve the minimum complexity with a system that, using the least possible amount of material, can convey multiple and variable spaces, with very few movements. Moreover, Changing Habit' can be employed in different cases of

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temporary sites: in fact, the system is based on a structure that is mobile itself, in its parts, in its different configurations.

Key words: Temporary constructions, innovation, low environmental impacts, assembly kit, reversibility and recycling.

Introduction

The work develops around the idea of temporary items in terms of project life, utilization and localization. In fact, a project can be defined as "temporary" considering both its possibility to occupy only temporarily the site and to be characterized by changing users. The aim is therefore to obtain a temporary construction that is capable of matching multiple and changing users' needs through simple technical solutions.

According to the considerable range of various users' needs, the study identified two different categories of temporariness: one that can be associated with structures for programmable events; the other one that can be associated with constructions for emergency situations. The first category addresses to the ensemble of projects for which it's possible to determine the beginning, the service life and the disassembly period: they refers to a large amount of constructions applied in different fields and characterized by multiple logistic needs, such as holiday residences, traveling structures or temporary facilities. The second category addresses to the emergency state, both of natural or anthropic type, in which it is not possible to know in advance whenever or wherever the structures will be used.

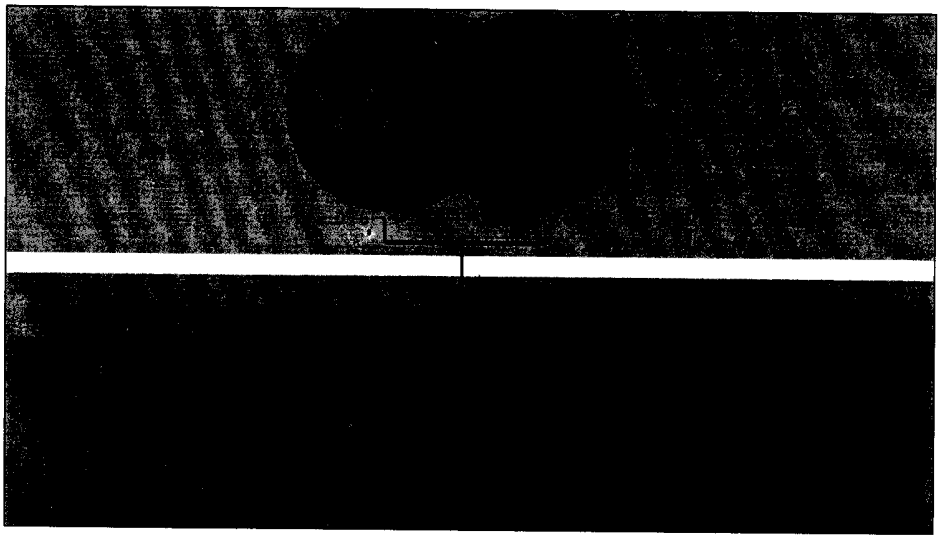


Figure 1: Synoptic of emergency situations and temporary structures: the goals

Although these two categories generate different typologies of projects, they both have origin from the same root concept of temporariness and deal with few basic but fundamental design paradigms, such as: independence, agreeability, easy way of assembly and pre-assembly. A critical analysis shows how the applications of these paradigms are temporary constructions, characterized by single modules, difficult to re-use and that can be employed only in very specific conditions and for a limited period of time. In addition, it seems clear that this type of design is basically responsible for a huge waste of resources: the idea of realizing a structure, and waiting for the occasion to use it, is in fact very inconvenient, both from the environmental and from economic point of view.

The System

According to these preliminary remarks, the project lies on a structure that can be used in different ways within the temporary categories, but always preserving the same structural and formal characteristics throughout its different way of use. The project aims to avoid the use of a single module and chooses instead to develop a system with changing and adaptable configurations: according to this concept, the system conveys the possibility to ensure the maximum typological flexibility. The concept phase brings to the design of an assembly kit composed of a definite number of simple elements and which generates a structure way more flexible than containers (that are often used in case of emergency situations) in terms of shape, space and use.

On the side of management of resources, the system has two main aims: on one side, to control construction and operational costs; on the other hand, to assure the structure reversibility and the recycling both of the whole structure and of its single parts. These characteristics drive the decision to use a two dimensional and moveable frame, made of a few linear elements, easily repeatable into space according to different configurations. Thus, the system potential and multiple possibilities lies in these very properties, reflecting the most free aggregation of spaces into the third dimension.

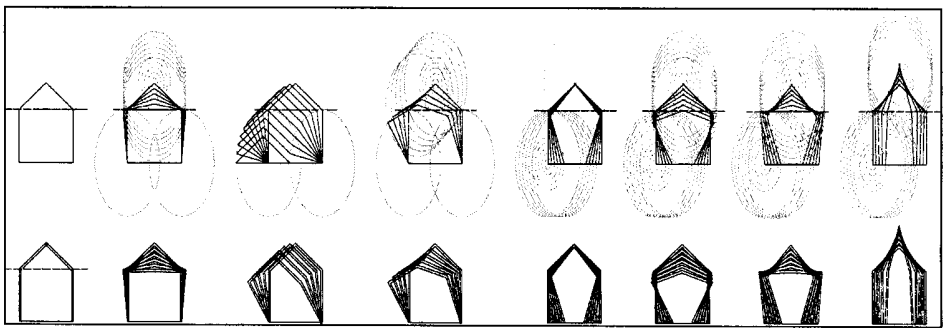


Figure 2: Geometrical variations of possible configurations.

Modular logic

The system is based on a key element that is the simple portal, used in different formal and dimensional settings. The simple portal is an entity geometrically defined for number, type and morphology of its elements and connections, and which can convey different and multiple scenarios, simply repeating itself into space. It basically determines the true connection point between the structures for programmable events and for emergencies situations. The basic elements that compose the portals are conceived according to both a modular scheme and to the maximum functional flexibility. Therefore a certain level of components movement is also provided through discrete motions of the portals, in order to achieve multiple configurations. This is possible thanks to the use of basic intersections which guarantees most manageable operations of assembly and disassembly.

Assembly kit

Finally, the project consists basically of a two-dimensional mobile frame, formed by bars and connection: thanks to few linear elements characterized by small size, it is possible to obtain a structure that is repeatable into space and that can assume multiple configurations. This structure is also characterized by the development along a longitudinal direction, by the use of portals as basic modular element, and by the movement of its own constitutive elements to achieve different configurations.

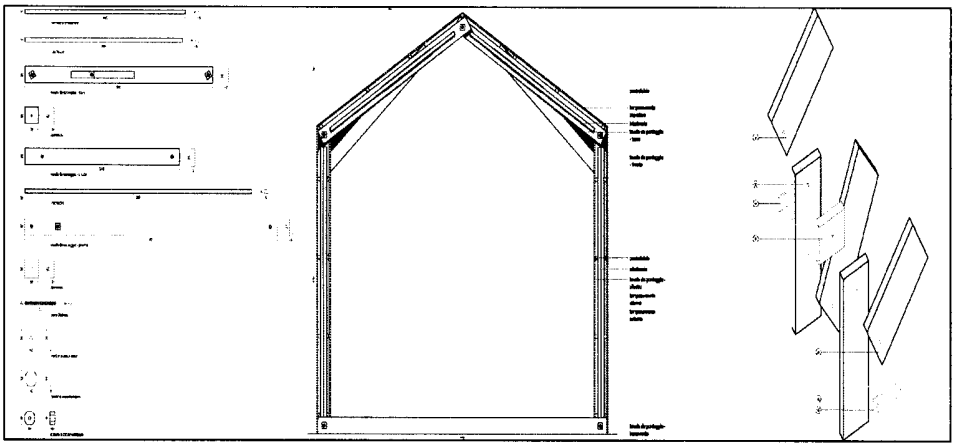


Figure 3: The portal and its elements; axonometric view of the simple connection.

The complete reversibility both of the structure and of the site where the structure is installed, as well as the chance to employ the least possible amount of material, make the project easily transportable and stored, with the least possible waste of space and environmental costs. Therefore, the system assumes a saving policy as primary goal, basically working on two substantial levels: on one hand, saving in terms of transport

and construction times; on the other hand, in terms of space, owing to reduced distance of transportation, to reduced stored dimensions and to reduced portion of terrain on the site itself.

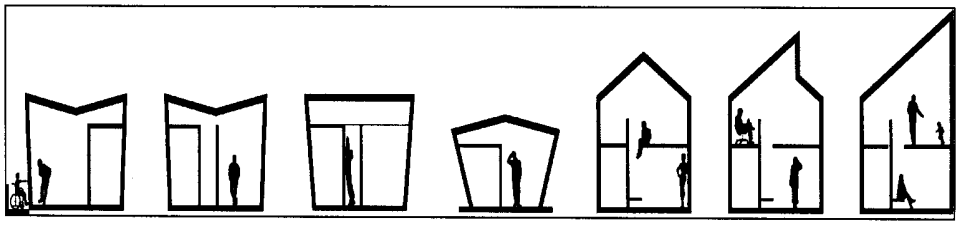


Figure 4: Multiple configurations; schemes.

Changing Habit' throughout Emergency Situations

Emergency situations force to operate in a very difficult environment, where it is of primary importance the role of management and the development of effective project strategies. According to this hypothesis, the system can be made of simple elements coming from a local pre-existent production, encouraging the use of standard elements. The portals are thus composed of wood beams that are easily available in most geographical and productive context and, above all, that are designed according to a strict modular logic. The result is a assembly kit based on few simple elements that allow to minimize the use of material and that can generate multiple living spaces, using simple movements and few devices.

In fact the roof beams have a milling cut for achieving a simple movement mechanism: the pivot, moving along the roof beam, slides into the milling cut and conveys the roof movement along with the change of configurations. Different movement degrees are conveyed by hinges made of simple elements available in most geographical and productive context, like threaded rod inlaid into beams and fixed by locking bolts and self-locking screw.

Multiple configurations

The basic structure refers to the minimum configuration used as a 18 sqm house for 1 or 2 persons, made of three portals, dimensions 510 x 514 cm. The system provides a basic equipment of living room with kitchen, a bedroom with toilet and spaces for the storage of personal effects. From this minimum configuration, the study proposes more solutions, from 30 sqm up to 52 sqm, for maximum 5 persons, made by the additions of portals to achieve larger spaces, or by the movement of portals themselves to achieve different morphological configurations, adaptable to different climates.

Elements of the assembly kit

Starting from the basic system of the portal, the study verifies the sub-systems details that convey variable habitable configurations, according to the environment in which they are employed.

Foundation and secondary structure: The foundation is made of prefabricated concrete plinths: the study assumes that each plinth can support up to 5 tons, weight heavier than the structure itself. Furthermore, the secondary structure hosts the internal partitions and is designed with the same modular concept as the portals that are the employ of wood standard beams coming from a pre-existent production. The resulting double beams offer a co-ordination space between elements that arouses the possibility of inserting and fixing additional elements, according to the users needs.

Interface sub-system: According to the same modularity of wood standard beams, the interface sub-system is realized to provide the easiest way of fixing both different types of external cladding and different thickness range of wall layers. The sub-system guarantees indeed an adequate interface for different materials, avoiding the addition of multiple elements of support for each kind of material needed.

Wall layers: This type of sub-system of contact allows not only the possibility of choosing different type of external cladding, but also enables a considerable variation of the thickness range of wall layers, to employ the best solution in each particular case, such as the possibility of a different range of the insulation according to the different environment. For example, the study proposes several wall layers hypothesis, referring to different climates conditions, to verify the effective system adaptability in various scenarios: for instance, in cold climate, the chosen solution is made of an external cladding, a ventilated enclosure, an insulation layer and the internal cladding; on the contrary, the solution in hot climate is made of a light external cladding and shielding against insects and water.

Roof: The modular logic of the system is also employed on the roof structure, in which the sub-system elements of connections are directly fixed to the portal beams: also in this case, the solution allows a simple support for the wall layers. The project uses a ventilated roof, studied with or without frames: the second solution allows the integration of thermal and photovoltaic panel support.

Frames: The project develops the possibility to incorporate into the structure pre-existent and standard elements also referring to frames: thanks to the already explained sub-system of connection, the project integrates the use of standard frames from construction sites, characterized by standard profiles, typologies and dimensions.

Benefits: Thus the project lies on a system typology that makes available a temporary emergency shelter, achievable in the shortest amount of time and in the cheapest way,

thanks to the employ of simple, easy to find and pre-existent elements. In fact, one of the project aims was to avoid the transition of affected population from tents for the first 72 hours, to containers for a period between 4 and 6 months, to prefabricated houses: reducing form three to two the population movements, the project will succeed not only in the goal of improving the population situation, but also of reducing wastes in terms of materials and transportation. Moreover, it is possible to bring the attention to three orders of factors, at the economic, at the environmental and at the social level. Thus, from an economic point of view, the system shows a lower cost per sq m than the three solutions below (container and prefabricated houses), in addition to more flexibility and adaptivity. Furthermore, since the elements employed into the system are easy to find in the context, there is also a significant reduction of the costs due to transportation. From an environmental point of view, the reduced elements dimensions and the easy way to find them allow the maximum exploit of the transportation space, with the result that the energy loss and also the carbon footprint will be massively decreased. In fact, the transportation of containers or prefabricated houses takes place with the movement of huge and basically void elements. Finally, from a social point of view, the easy assembly allows the possibility of building the system in a short amount of time by unqualified workers: in this way the labor costs will be invested in the local area instead of directing them towards other places.

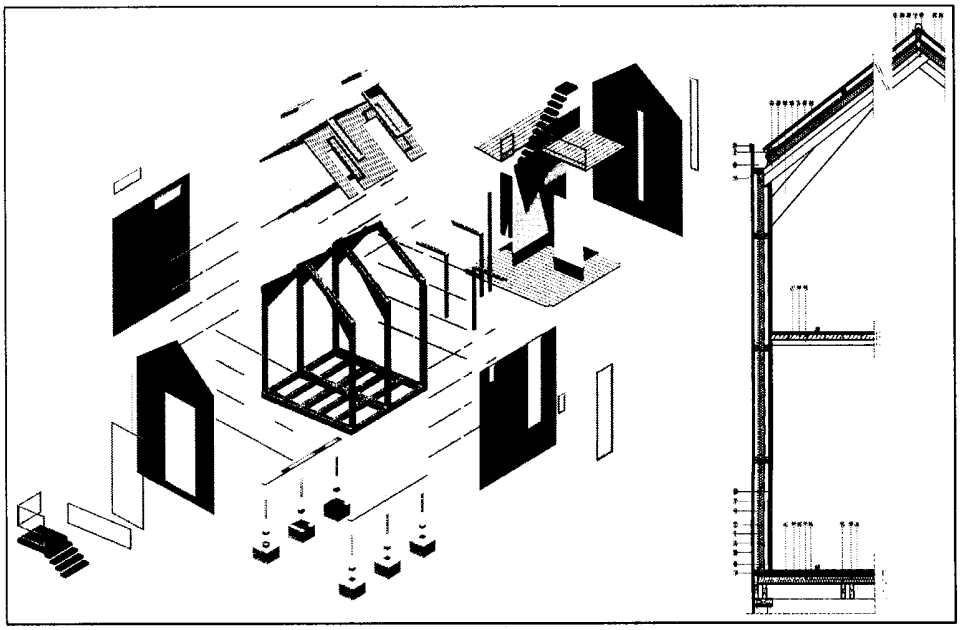
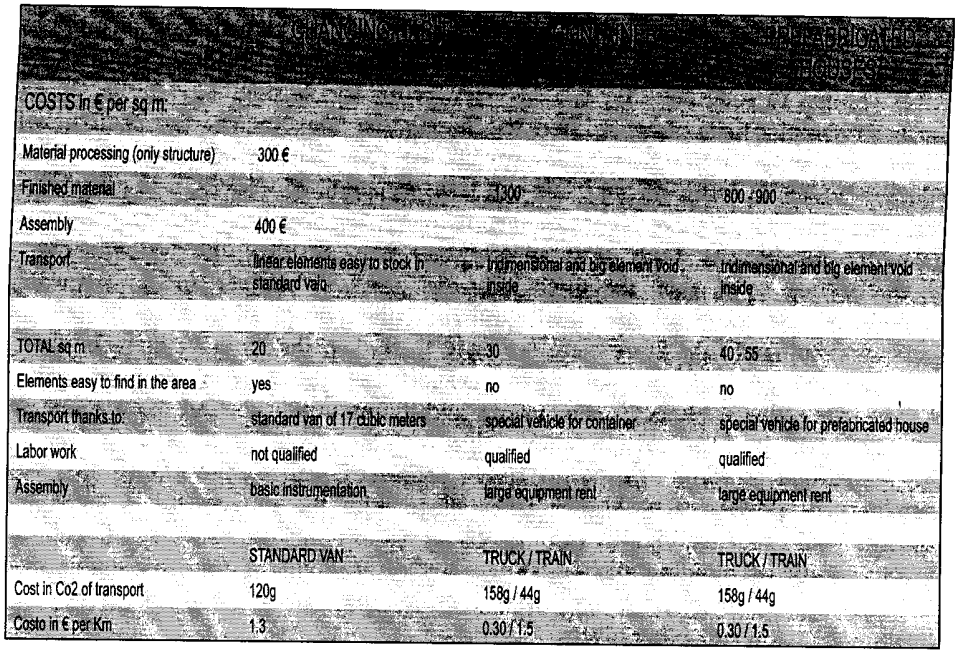


Figure 5: The assembly kit for emergency situations; exploded axonometric view and section



COSTS in € per sq m			
Material processing (only structure)	300 €		
Finished material		1300	800 - 900
Assembly	400 €		
Transport	linear elements easy to stock in standard van	tridimensional and big element void inside	tridimensional and big element void inside
TOTAL sq m	20	30	40 - 55
Elements easy to find in the area	yes	no	no
Transport thanks to:	standard van of 17 cubic meters	special vehicle for container	special vehicle for prefabricated house
Labor work	not qualified	qualified	qualified
Assembly	basic instrumentation	large equipment rent	large equipment rent
	STANDARD VAN	TRUCK / TRAIN	TRUCK / TRAIN
Cost in Co2 of transport	120g	158g / 44g	158g / 44g
Costo in € per Km	1.3	0.30 / 1.5	0.30 / 1.5

Figure 6: System benefits from the economic, environmental and social point of view

Changing Habit' as Temporary Structures

The system is able to satisfy not only emergency situations but also temporary events. In terms of temporary constructions, the study develops the project starting from the same primary concept of the system composed by a mobile frame of beams and intersections. The solutions proposed belongs to a group of structures that can also apply to elements designed ad hoc. Such a system lends itself to the employ of other situations than the emergency ones, such as holiday residences, information points, traveling structures, temporary facilities or exhibition installations. According to this field of application, the project focuses more on different typologies of intersections than different configurations.

The connections

Thus the study introduces a series of design proposals that, starting from the use of the same elements of the emergency kit, proposes a range of possible suggestions with the employ of ad hoc elements, but still preserving the basic two-dimensional mobile portal.

Simple connection: The proposal of a simple intersection lies on the use of a sub-system of connection that allows the employ of elements with different profiles,

without adding extra components. Such a solution guarantees an easy interchangeability of elements, avoiding a significative change of the intersection elements: it consists, in fact, of a simple plate adapter on which the sub-system of connection is applied for both rectangular and tubular profiles.

Gears connection: This solution addresses forms and technologies of mechanical elements, referring to the artistic and imaginative trend of Steampunk, in which steam technology and mechanical engineering are combined. The resulting intersection is composed by two gears rotating in two opposite directions, till they reach the beams position determined by the chosen configuration. The mechanism is completed by a third smaller gear that locks the entire structure movements, thanks to a joint plate element characterized by a milling cut thorough which the smaller gear shifts from the position A of lock, to the position B of rotation.

Electromagnetic connection: This solution proposes to exploit electromagnetism to support the portal beams. The idea originates from the field of kinetic sculpture, so close to artistic installations or temporary facilities that interests the project: particular interesting is in fact the work of the greek sculptor Takis, with his series called "Telesculpture". The intersection proposed is basically made by the repulsive force, generated by two contrasting electromagnetic fields, developed by two solenoids: devices that allows to tune the intensity of the force changing the amount of current that passes through them.

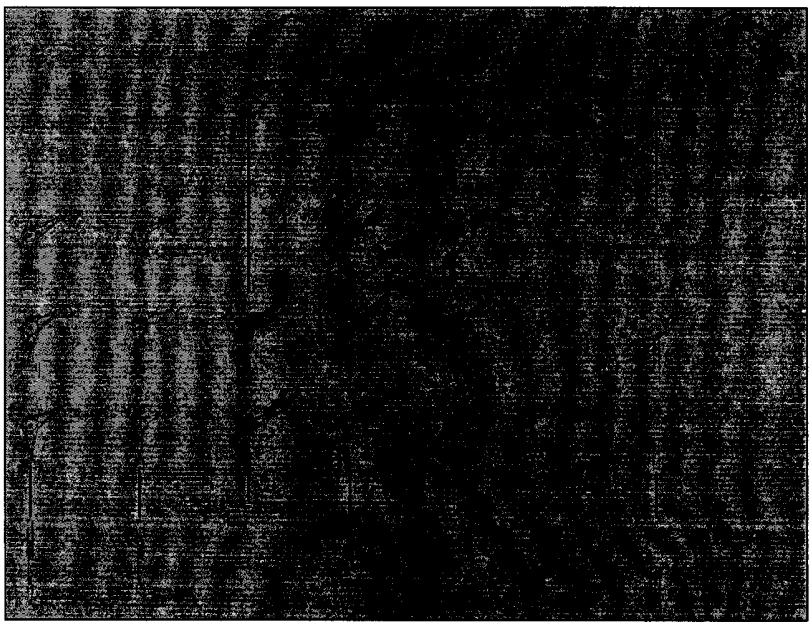


Figure 7: Synoptic of possible connection solutions.

Additional elements

Textile system: To speak in terms of temporary constructions also means to approach the theme of the textile architecture, in order to exploit its characteristics of lightness, light transmittance, modularity and easy assembly. Thus the study proposes the realization of a convertible textile structure that can modify its morphology while at work. The proposal provides three basic configurations: the ponding one, in which the textile membrane is at rest; the position A, in which the membrane assumes the first condition of pretension; and the position B, in which the membrane reaches the condition of maximum stretch.

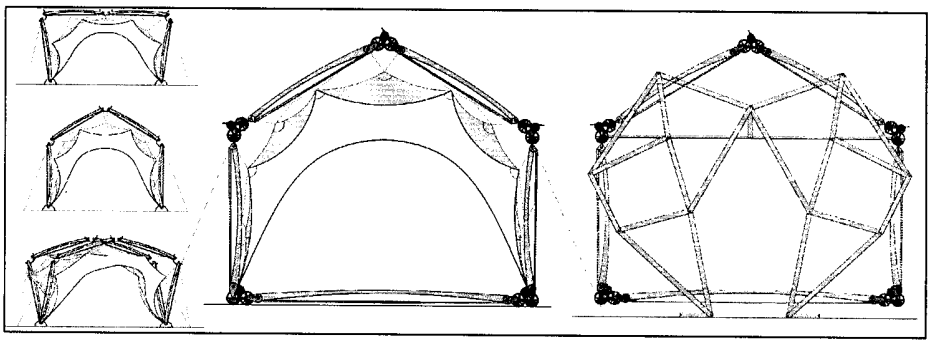


Figure 8: Three basic configurations of the textile system and the Strandbeest system.

Strandbeest system: According to the aim of adaptability to different environments, the system can be modified in its configurations, according to different degrees of flexibility. At the edge of its possibilities, the study gives to the system the higher level of freedom thanks to the use of the so called Strandbeest by the dutch sculptor Theo Jansen. The displacement happens thanks to the rotation of each feet after the movement of a mechanical leg made by proportioned eleven segments. Such a system adds to a simple structure like the design system, the possibilities of kinetic architecture, exploiting a broader field of user's experiences.

Concluding Remarks

The system, both for temporary structures and for emergency situations, assumes as target the creation of a multiplicity of spaces, times and objects: the result is a range of miscellaneous and multidimensional items opened to a variety of relationships between themselves. According to this interpretation, time is expressed by the movement of the system itself which generates a range of different spaces and forms within its multiple configurations. Thus the choice of the name Changing Habit' seems appropriate to a system conceived in this way: the name plays on the term habitat, reduced to habit, that means acquired pattern of behavior that often occurs

automatically. It's indeed possible to talk about multiple pattern of behavior that the project proposes to living spaces achieved by a system that is mobile itself, in its parts, in its different configurations and in its entirety.

References

[1] Luigi Cavallari, Abitare e costruire in emergenza: tecnologie per l'adeguamento dell'habitat provvisorio, Pescara: Sala, 2003;

[2] AAVV, Architectures modulaires economiques, Paris: Place des Victoires, 2009;

[3] Robert Kranenburg, Houses in motion: the genesis, history and development of the portable building, Chichester: Wiley-Academy, 2002

[4] Massimo Perriccioli, La temporaneità oltre l'emergenza: strategie insediative per l 'abitare temporaneo, Roma: Kappa, 2005;

[5] AAVV, Living in motion: design and architecture for flexible dwelling, Weil am Rhein: Vitra design museum, 2002.