

## Viable Housing Edification: a Self-help Prototype

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### Abstract

This contribution, gained over experience in Dipartimento di Ingegneria dei Sistemi Edilizi e Territoriali of Politecnico di Torino [2], aims at proposing “simplified assemblage” wooden building constructions, to face problems of temporary structures in border-line areas. To manage the whole process a multimedia system for handling information has been adopted. Main results are:

- design building system with details and tools able to:
  - a) define three-dimensional features respecting environment, suitable to construction and modifiable on site (with design of all construction nodes and realization of basement for connection on ground in 1:1 scale);
  - b) design and realize an “all-in-one” tool to build up structures without other utensils;
  - c) foresee repeatable construction phases, easily and quickly understandable;
  - d) conceive procedures (using instruction fiches), to avoid injuries and minimize risks;
  - e) simplify shape of elements interchangeable according to given dimensional coordination;
  - f) separate units in parts simple to be reproduced (with specifications).

Besides, necessary steps have been taken to:

- allow users to be independent in construction operations;
- adopt self-building and “dry assembly” procedures;
- employ recyclable and easy to work materials, functional to adjustments during assembly phases;
- use of regional woods to revalue local resources [6];
- foresee usability of all topics, especially on web (<http://www.polito.it/eas/>) to stimulate implementation;
- guarantee interaction of users with multimedia, to support self-builders in construction phases;
- handle 2D/3D models simultaneously to clarify building techniques;
- manage “driven choices” defining typology of territorial development, layout, foreseen use and number of persons hosted in temporary houses;
- provide all information needed to manage village at its best (self-help manual).

The final outcome is a Multimedia containing all contributions to help users in self-building of village.

## 1 Introduction

The idea to realize a prototype of self-help building residence able to suit the most different conditions of application, results from the analysis of what has been realized up to now [3]. A lot of interesting solutions have been proposed by other authors. The following details are common to all proposals:

- a) oneness of development (because premises of departure are “unique and unrepeatable”);
- b) differentiation of adopted technological means (depending on needs to be satisfied).

Obviously the above principles are thought to solve a temporary need (exhibitions, itinerant fairs, ...); others satisfy a desire of a house of longer term (wooden prefabricated, vacation houses, ...); some are turned to particular users or geographical areas (Third World, Developing Countries, ...); a few are applied to situations of extreme gravity (emergency housing following catastrophic natural events). Therefore, it is essential to propose “simplified assembly” solutions that enable the followings [2]:

- adapt them, as much as possible, to context;
- foresee repeatable assembly phases, quickly understandable, adopting self-building procedures;
- employ recyclable and easy to work materials, functional to assembly adjustments [2,4,5].

Besides intervention framework shaped during this research, calls for choices that enable integration of external staff - properly trained to build houses - and of people who, because of social level, job, age and interests, might have no previous experience in that regard.

Beginning from this premises, wood has been held the most adequate material to meet the requirements above mentioned [1,2,5], such as the choice of “simplified dry assembly” procedures which prevent operations of sticking or casting and allow revaluation of regional wooden species [6].

The self-building solution has been subdivided into its independent technological units:

- structure of foundation;
- structure of elevation;
- opening devices;
- horizontal inferior closing;
- opaque & transparent closing;
- superior covering.

## 2 Analysis of parts composing the prototype

As seen in the above chapter, let's try to analyse the peculiarity of single construction details. It's to be underlined that treatment cannot go over the form of summary, for evident problems of synthesis.

### 2.1 Structure of foundation

It's composed by (see Table 1 & Figure 1):

- a cross settled to the vertical uppercuts, on which to screw “L” trims to hold in position pillars and principal and secondary beams (the latter compose the floor support);
- an interface parallel to the ground (on which to screw elements engaged in the ground);
- some steel alloy bracings, usable only according to some particular positions;
- nuts and screws limited to measures M12 and M18;
- standard profiles, easy to find in commerce and very light at single component part level.

What's the meaning of the adoption of features above quoted? (Alphabetical order as followings)

Table 1: Characteristics of foundation structure

Peculiarity	Description	Meanings
Lightness of each element	- minimization of weight of every part	- even a girl - max weight imposed by legislation: 20 000 g - can handle components
Standardization	- only use of M12/M18 bolts	- employ of a single tool instead of more utensils

	- apply of standard profiles	- simplicity of management & interchangeability
	- “obliged position” of some elements	- reduction of misunderstanding or erroneous installation (see “steel alloy bracings”); - face of screw head beats against one of bracing sides of central block (you can screw in nuts from external side using only a tool - safety!)
Sustainability	- materials employed (valid for all the followings)	- all elements derive from nature and can be recycled or used according to other shapes

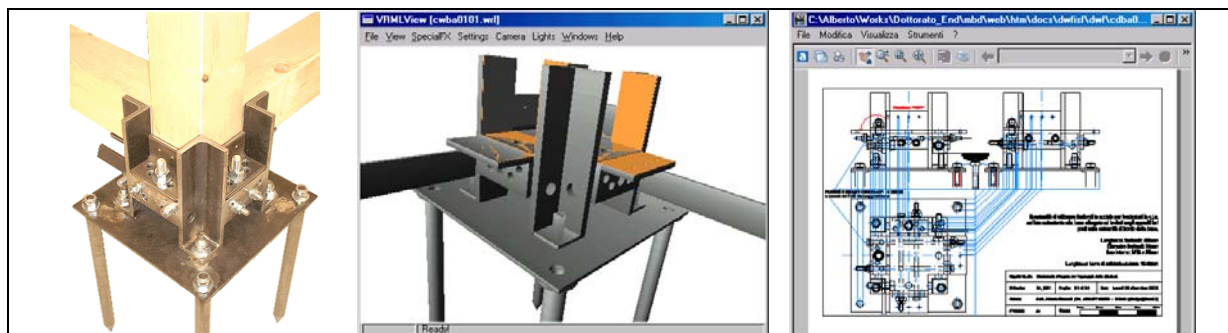


Figure 1: Some references for foundation node

## 2.2 Horizontal inferior closing

Constituted by (see Table 2 & Figure 2):

- stratified wooden cross, nailed on principal and secondary beams (linked to foundation node);
- standard profiles, easily obtainable from other elements and lightness of single component parts.

But what does this mean in practice?

Table 2: Horizontal inferior closing peculiarities

Peculiarity	Description	Meanings
All season applicability	- use of wood (superior face) and insulating panel (bottom)	- in this way you can use this technological details always and for all kinds of territorial sites
Lightness	- see chapter on “Structure of foundation”	
Perfect hold	- high accuracy of assembly	- atmospheric agents mitigated and animal proof
Standardization	- use of simple shape profile	- possibility to obtain them cutting other ones
	- same shape for all kind of floors (1500x1500x60)mm	- simplicity of management, easy interchangeability and universal application
	- “obliged position” of parts	- no misunderstandings or erroneous settings

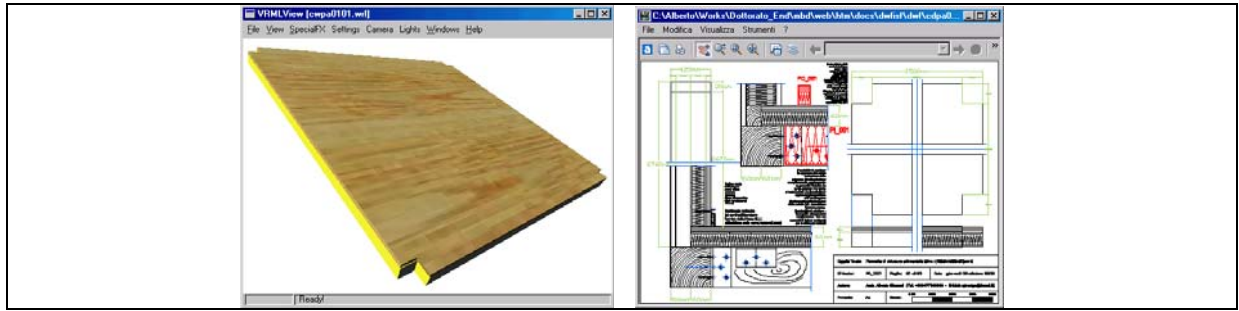


Figure 2: Images about horizontal inferior closing

### 2.3 Structure of elevation

Formed by (see Table 3 & Figure 3):

- wooden poles (2880x120x120)mm bound to plinths and supported by vertical opaque closing panels (2760x1380x120)mm. The shape is obtainable with simple and easy-to-use utensils;
- lightness of each element.

But how can we convert this into interesting suggestions?

Table 3: Description of elevation structure

Peculiarity	Description	Meanings
All season applicability	- wide thermal isolation	- in this way you can use these technological details always and for all kinds of territorial sites
Lightness	- see chapter on “Structure of foundation”	
Perfect hold	- see chapter on “Horizontal inferior closing”	
Standardization	- use of simple shape profile	- possibility to obtain them cutting other ones
	- same shape for all kinds of vertical developments	- simplicity of management, easy interchangeability and universal application
	- “obliged position” of elements	- reduction of misunderstanding or erroneous layouts
	- employ of this element for composing other ones	- from this detail you can build up a door or a window according to dimensional coordination

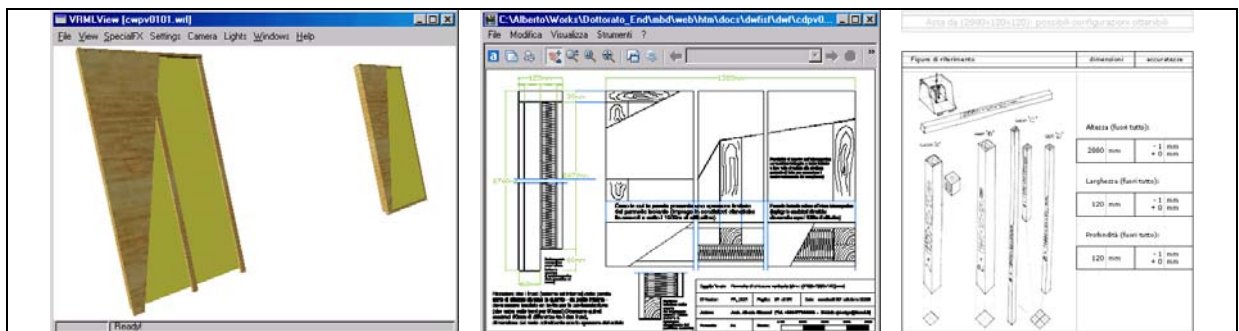


Figure 3: Sample of elevation structure & one dimensional coordination fiche (on right)

## 2.4 Vertical opaque & transparent closing

Vertical opaque closing. Made by (see Table 4 & Figure 4):

- vertical opaque panels (wooden poles and boards in which a thermal block is “drowned”);
- measurement: (2100x900x60)mm;
- it can accept standard windows and doors or you can apply the ones derived from this study;
- easily transportable because of lightness and shape (as all other technological details).

And its peculiarity?

Table 4: Features of vertical opaque closing

Peculiarity	Description	Meanings
All season applicability	- see chapter on “Structure of elevation”	
Lightness	- see chapter on “Structure of foundation”	
Perfect hold	- see chapter on “Horizontal inferior closing”	
Standardization	- see chapter on “Structure of elevation”	

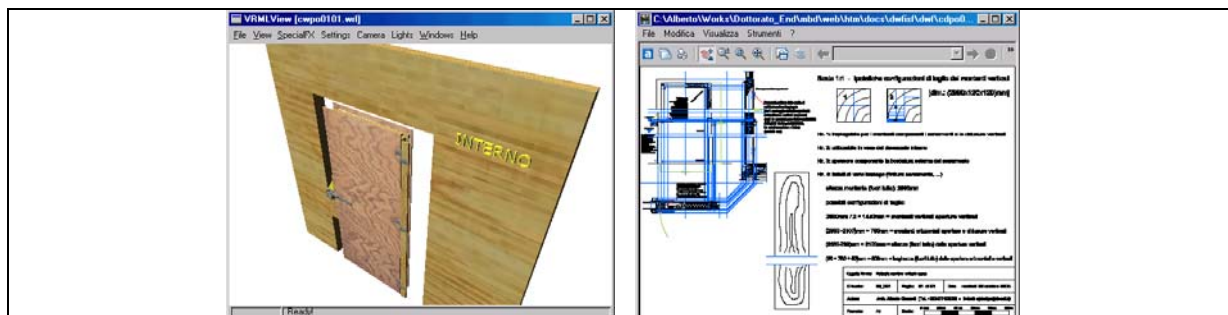


Figure 4: Vertical opaque closing prototype

Vertical transparent closing. Done by (see Table 5 & Figure 5):

- vertical poles on which to screw plastic panel covered by a wood frame (1440x900x60)mm;
- window and door closing is got through wooden poles drawn cutting the ones composing structure of elevation;
- easily transportable because of element lightness and shape.

And why to use this element instead of the standard one?

Table 5: Vertical transparent closing specifics

Peculiarity	Description	Meanings
All season applicability	- see chapter on “Structure of elevation”	
Convenience	- assembly can take place on site	- if an element is lacking, it’s possible to build it up with units coming from other works
Lightness	- see chapter on “Structure of foundation”	
Perfect hold	- see chapter on “Horizontal inferior closing”	
Safety	- use of plexiglass instead of glass	- in this way, during transport and laying, it’s difficult to hurt oneself because plastic is lighter and so it can be moved in a safe way

Standardization	- see chapter on “Structure of elevation”
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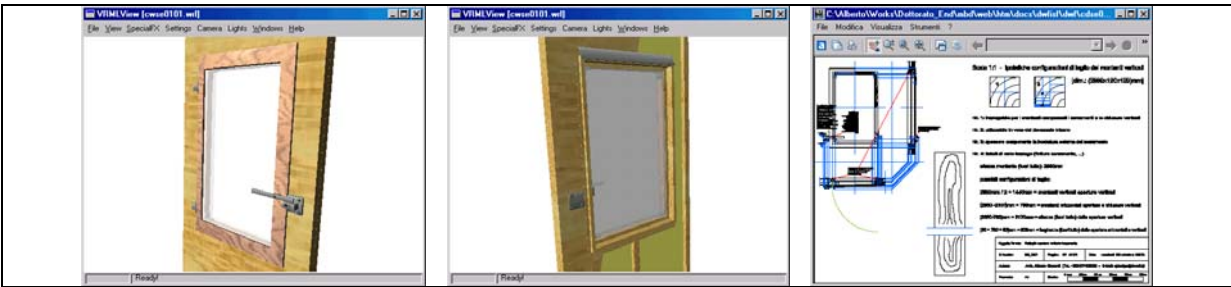


Figure 5: Vertical transparent closing. On left and center inner and outside sight; on right CAD view

**2.5 Opening devices**

Manufactured by (see Table 6 & Figure 6):

- little pieces of steel preformed bars linked together to obtain a unique element;
- piercing screw with nuts inside opening (while the screw head is blind);
- easily transportable because of component lightness and shape.

And what about using this element instead of the standard one?

Table 6: Opening devices properties

Peculiarity	Description	Meanings
Convenience	- see chapter on “Vertical transparent closing”	
Lightness	- see chapter on “Structure of foundation”	
Perfect hold	- see chapter on “Horizontal inferior closing”	
Security & Safety	- employment of zippers on doors and windows inside and not outside the residence; - adoption of fit padlocks (inside residence); - external pivots with blind head (therefore unscrewable)	- in this way, it’s very difficult for thieves introducing inside houses; - at the same time, instead, the abandonment phases are favoured for occupants in case of fire, ... (this because all closing elements - lock and so on - are inside and, therefore, not reachable from robbers)
Standardization	- see chapter on “Structure of elevation”	

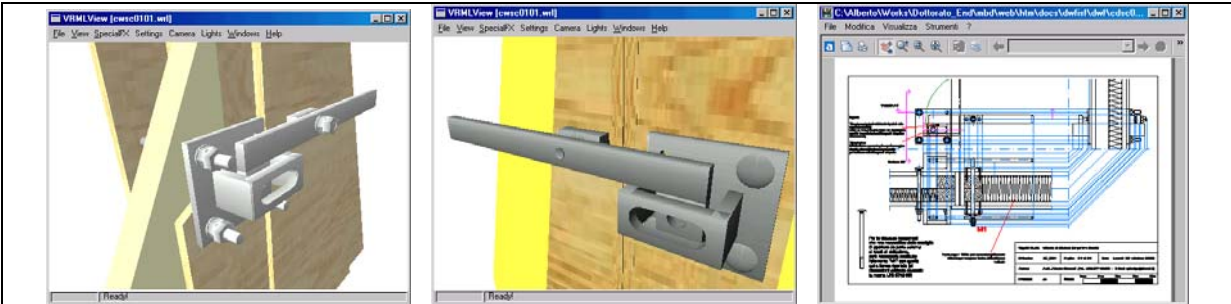


Figure 6: The lock system as studied

## 2.6 Superior covering

Organized around (see Table 7 & Figure 7):

- stratified panels (same as ones used for “Structure of elevation”), leaning on wooden struts;
- lacking of tiles (all elements necessary to keep out external agents are included in panels);
- water cannot go back up or penetrate inside thanks to junction elements studied for this goal;
- easily transportable because of component lightness and shape.

Why use this element instead of standard type of covering?

Table 7: Features of superior covering

Peculiarity	Description	Meanings
All season applicability	- see chapter on “Structure of elevation”	
Convenience	- see chapter on “Vertical transparent closing”	
Lightness	- see chapter on “Structure of foundation”	
Perfect hold	- see chapter on “Horizontal inferior closing”	
Security & Safety	- the panels can be walked on by people; - no animals can penetrate inside buildings	- you can build it up preserving safety of operators during construction phases; - this covering system, not using tiles, it’s quick to assemble using only ladders
Standardization	- see chapter on “Structure of elevation”	

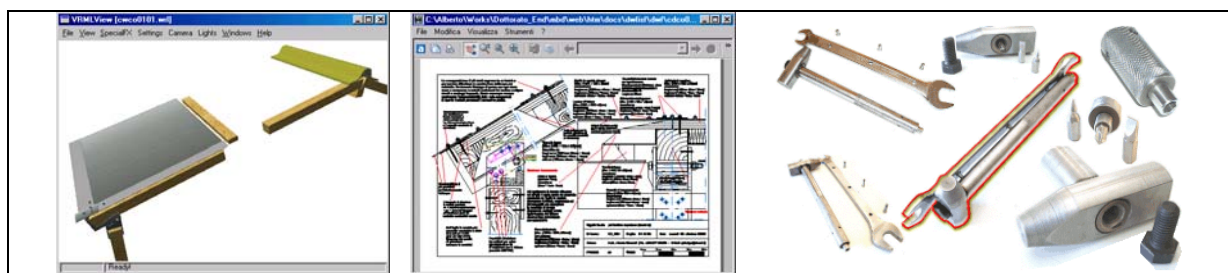


Figure 7: The way for covering self-help buildings - Figure 8: (On right) The self-help building tool

## 3 Tools for management of building operations and information sharing

### 3.1 Adequate “all-in-one” tool to build up self-help housing

The tool realized (Figure 8 above) implies adoption of two utensils, able to concentrate the 6 principal functions necessary for self-building structure assembly.

Being constituted only by two parts, occupied space and loss are minimised.

The multi-function tool contains:

- an opposition of a spanner for M18 metal screws and nuts and one for M12 bolts. Both keys have been studied to enable tightening of all types of bolts reduced to measures above mentioned;
- alloy steel mallet with a magnetic hexagonal pins holder, fastened to the hollowed bottom of handle through 4 mm diameter threaded bars, for the fitting in of pins necessary for installation of self-building structures, enabling following functions:

- screwing/unscrewing of phillips screws and tightening/un-tightening of plane screws;
- carving of wood elements to make screwing easier (ferrule can have different shapes).

As regards alloy steel mallet, the feature of being hollow and closed on one extremity by pin holder and on the other by a thread screw (M12), enables the keeping of all ferrules inside handle (preventing eventual loss) and a considerable lighting of mallet weight. Moreover, this kind of “all-in-one” tool is useful for every kind of job concerning edification and yard management and so every builder can work without searching for other complicated and difficult to find utensils.

### **3.2 Multimedia and fiches for organization and diffusion of various contents**

It is important to dwell upon relevance of multimedia organization of data and fiches (specifications and assembly ones) used to diffuse information. To this regard, design and realisation respond to the necessity of making notions easier to be understood. They can be consulted on site and, properly combined with “self-help building manual”, be filled out in hard copy. Their final objectives are:

- propose already tested layouts, ready to be reproduced on territory;
- define responsibilities to be covered by different stakeholders which will act in situ;
- supervise activities assigned to charged people, organising intervention teams;
- foresee repeatable construction phases, easily and quickly understandable;
- conceive procedures to avoid injuries and minimize risks, allowing users to be independent in construction operations and verifying that timing fits the one pointed out in Gantt diagrams;
- establish what priority necessities are, to prevent possible shortages and reduce risks for man and environment, helping people to foster belonging to community;
- evaluate critical points, thanks to effective tools of survey.

### **3.3 Glocal dimension of web site (<http://www.polito.it/eas/>)**

The web site has been realised to allow:

- examination of real validity of technical and design solutions proposed in the study;
- real comparison between experts, to increase research subjects in real time;
- support to operators who will work in site, thanks to useful sections aimed at complete handling of village yard.

## **4 Conclusion**

The main aim of the research here proposed is to represent the basis to deepen various topics related to the design and industrial production of self-help innovative construction using self-help made viable. The success of this kind of intervention implies a raising awareness of importance of constructive nodes studied to make sure that all works well (at tolerance level, accuracy of assemblage, safety, ...) and of technological details simplification to help the subjects involved in edification phases to reach full autonomy during building and management steps. Moreover, thanks to multimedia communication tools, utensils, fiches about specifications and assemblage procedures, website, and so on, a real integration of knowledge becomes feasible, as well as a comparison between experts and workers/final users. The continuous update of this research tools and the collection of data and virtual model handling, can allow information to be clearer for anyone.

New frontiers of development are opened due to presence of this kind of instruments, modifiable in real time. It's time to ask ourselves: “Are we ready to accept the challenge?”.



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