

## **EXPANDABLE DWELLING SYSTEM – FOR CHEAP AND FAST ERECTION AND DISMANTLING**



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### **Summary**

Our idea consists in providing the simplest possible unfolding structures, in particular for temporary housing. Its acronym EDS stands for Expandable Dwelling System, based upon the licensed technical solution „Collapsible construction kits“ and „System for position fixing of collapsible construction kits“. It is available in one-floor or multi-floor versions. It can be easily shipped from the factory to the site of disaster, including air transport. The erection, possibly with replaceable external walls, is a matter of a few hours, depending upon the number of modules that should be put together. If they are needed somewhere else, nothing is easier than dismantling, renovation, if case be, and repeated installation. As a rule, no additional components are needed to facilitate the transport. After the end of service life the parts can be recycled. If compared with other standard modular systems, EDS is unmatched as to the ease of handling and installation, requiring neither special fittings, nor skilled labour or trained supervisors...

**Keywords:** Expandable dwelling system, Collapsible construction kits, System for position fixing of collapsible construction kits

### **1 Introduction**

EDS offers its advantages for diversified use, and namely from ground-floor to more-floor systems. The EDS system can be preferably used as a carrying structure combined with various available boards or panels. The EDS systems were needed by hundreds for housing constructions in Kosovo and also in Turkey after the earthquake, but the manufacturers were never able to cope with the demand...

### **2 Examples of embodiments:**

- Container type modules ISO1 C and CC for housing and storage
- Houses developed from containers ISO 1 CC of various sizes

- Set-ups of field hospitals using containers ISO 1 CC
- Multi-floor (up to 5 floors) housing systems based on ISO 1 CC ground plan (4 x 12 meters), the inside height equaling the width of the modules
- Houses and modules of houses with both system based and current floor (module size from ISO 1 CC up to 4 x 12 meters and more)
- Mobile houses including two-floor ones
- ISO containers for storage, transport and naval transport, 20 and 40 inch types..

### 3 EDS applications

#### 3.1 EDS 20' – ISO CC 20 container – one-floor

##### Characteristics

The essential innovative element in this series of models is the use of fixing elements. This type of container is functionally folding, much like prefab constructions. Such concept, allowing cutting down the erection time quite dramatically, allows easy and cheap relocation of the container.

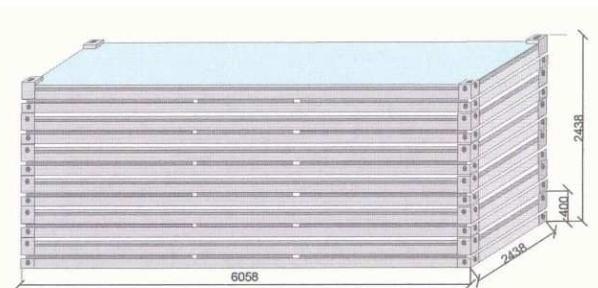
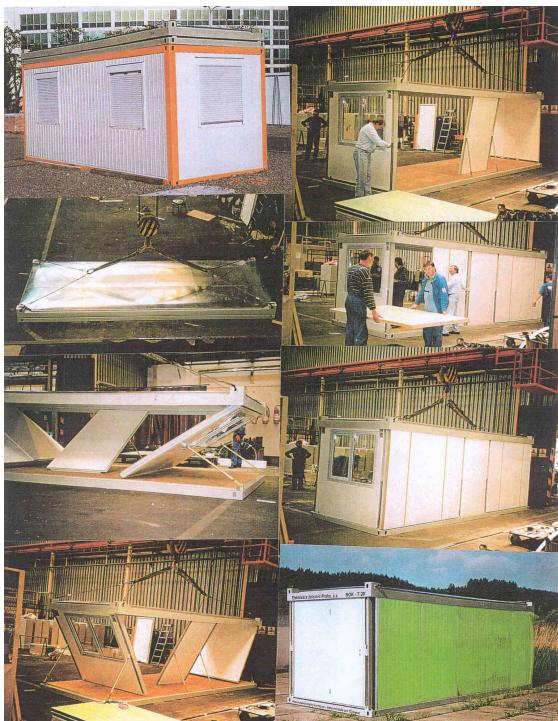


Fig.1. The composition of six composed living Containers 2438 x 6058 x 2435 mm

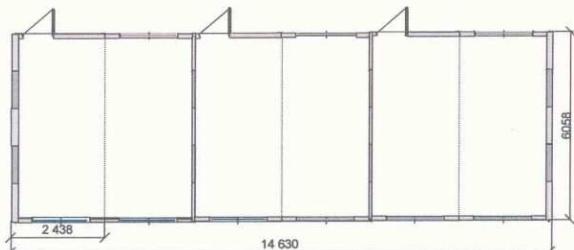


Fig.2. The composition of six living Containers 14630 x 6058 x 2438 or 2591 mm internal height 2150 or 2300 mm

##### Fig. 1 Description of the procedure and the illustrated phases

Left: The installation of bottom container ISO 1 CC (height 2591 mm) supporting the upper container type ISO 1 C or CC (height 400 mm). → Time 0-2 minutes. The assembled container suspended on crane. → Time 2 minutes 20 seconds. The first phase of the unfolding of the container. → Time 2 minutes 30 seconds. The second phase of unfolding. → Time 3-6 minutes. Fixing of the upright walls against collapsing. → Time 6-8 minutes. Installation of the complementary 4 panels of the longitudinal wall, the cables of the crane can be released. → 8-11 minute – the whole set gets fixed. 11-15 minute – hidden work inside. → A view of three walls of the container. The electric installation can be seen above the window corners. → A view of the container with four walls. Various covers, e.g. the one above the gap between the containers, are not yet in place. The remaining work should not take more than 15 minutes.

## Unit

The basic unit consists of a floor, a ceiling and two shorter opposite walls with one installed window. The electrical fittings are already in place and pre-wired. The unit has 3 or 4 external walls consisting of insulated panels fitted with doors and/or windows according to customer requirements. Folded containers are delivered separately or in a transport pack (in accordance with ISO) of 6 pieces that will be sufficient to provide a complex measuring  $6.1 \times 14.6$  m.

**Folding and unfolding time** of one container is from 15 to 30 minutes, or 10 minutes with a crane. The installation of a set of 6 containers (total area  $88.4 \text{ m}^2$ ) takes from 1 to 3 hours by four people and one crane (time depending upon the number of additional panels).

## 3.2 EDS Cottages

This modular system can replace dwellings in areas struck by disaster and can be applied in all sorts of unexpected situations requiring temporary accommodation with minimum impact upon the countryside, leaving practically no permanent traces after having been removed.



Fig. 2

## Characteristics

Expanding one module takes surprisingly little time (about 30 minutes even for a team of unskilled workers), and the unit can be also very easily relocated.

**Solutions implementing EDS**, as compared with current housing containers, are simple, inexpensive, and variable, enabling good looking and expandable structures that need not necessarily serve for temporary requirements only, offering many features for which they can be used also for permanent dwellings, such as the certified sandwich system providing

excellent heat insulation. Adding another module to comply with the growing demand of space is easier than anything. These structures do not need any expensive earth moving operations or special foundations, either; simple levelling is enough.

### **Transportation and realization**

Minimum inner headroom of a standard housing unit is 250 cm, which causes problems during the haulage of non-folding modules. The transportation cost of EDS systems is a fraction of the current standard costs. One towing vehicle of 13,5 m length can transport up to eight folded modules with total floor area 160 m<sup>2</sup>, enough to build, e.g., four complete housing units with two rooms and a kitchenette, or double units with two rooms allowing to accommodate families of two, three or four persons. It is possible to assemble groups of dwelling units by means of a single crane within one day only. Next morning the families can move in. The housing units offer similar living standard as prefabricated panel house flats, and even better standards than some village cottages, in particular concerning inner space solutions, aesthetic features and overall utility value. In knocked-down condition the height is 500 mm / 850 mm. In expanded state the minimum height is 2800 mm / 3150 mm. The ground floor area of each module is 20 m<sup>2</sup>, (6,65×2,99 m). A complex of two or three modules standing freely can, by way of example, combine modules **A** with modules **C**.

### **3.3 Mobile two-storey houses**

Many people prefer two-storey houses, but the transportation and construction problems are considerable. We have solved them by designing a foldable first floor that is knocked down during the transport, supporting the completely fixed upper floor, usually with a ridge roof. Such second floor contains two to three bedrooms and a bathroom (with basin, shower bath or tub and a closet), the living room and the kitchen are downstairs and their furniture and appliances, including the stairs, are designed so as to allow easy dismantling and renewed installation.

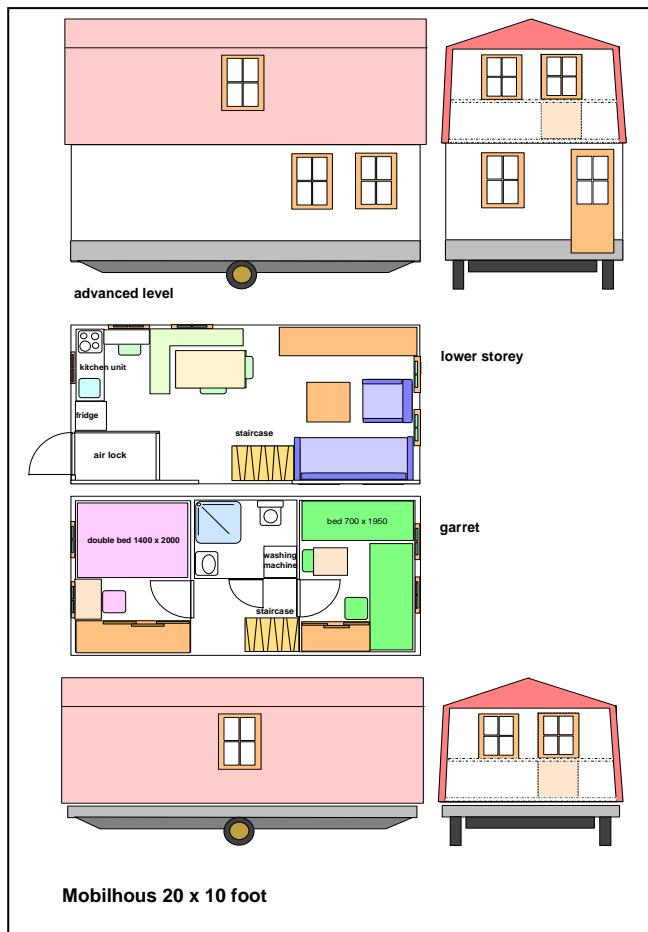
#### **Characteristics**

The erection of the first floor does not require a crane, a jack will do. With some practice the erection can take as little as an hour. There is a choice of diversified elements and partition walls, including optional components for the exterior. The height of the interior varies between 2100 and 2600 mm.

#### **Technical description**

The folding entity consists of prefabricated components: the floor, the opposing shorter walls with a window or door, providing the carrying structure of the second floor that accommodates bedrooms and a bath. The first floor will be completed by the longer sides having windows or doors in optional set-up. The electric installation is built into the ceiling and connected with the wiring of the foldable walls. All sorts of layout are possible, combining different modules and different materials. This principle applies also to the truss of the roof structure that can be made of wood, steel, or composite material. The sanitary installation of the second floor is fully functional, and the only thing to be done upon arrival to the site is adjusting and fixing the vertical pipes and tubes, as well as the connections of a kitchenette.

It goes without saying that the outer coat can be made in many ways, from acrylic paint down to wood-like panelling.



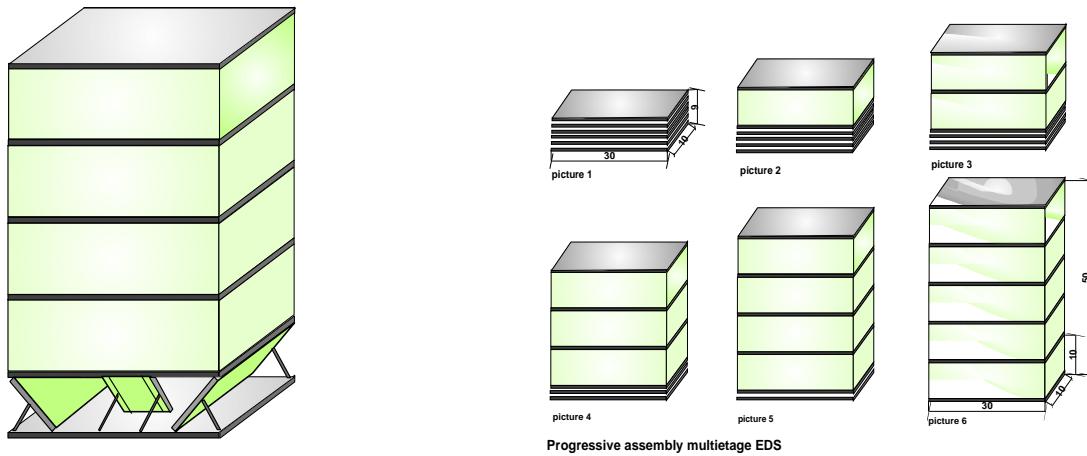
**Fig. 3**

### Transportation and mounting

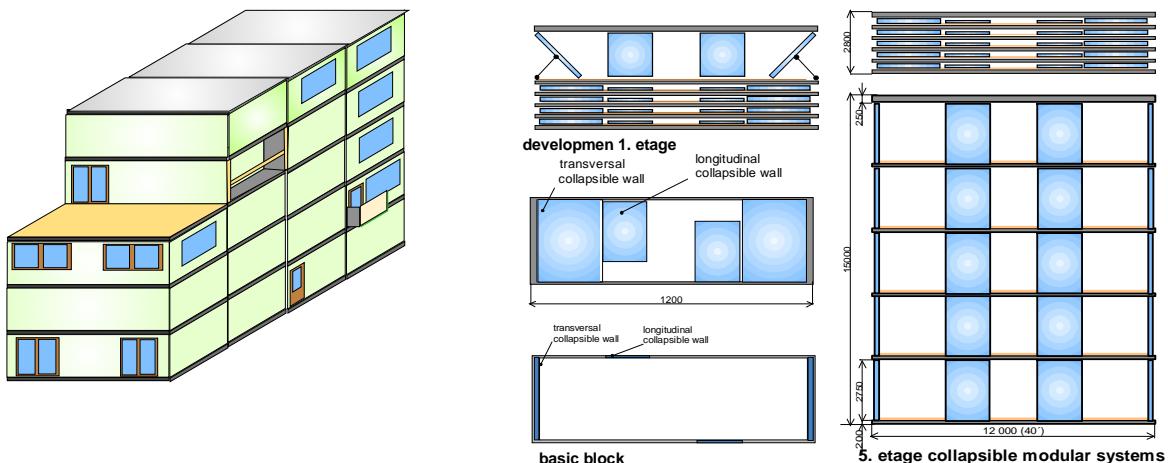
Many details have already been mentioned above. Upon arrival to the site the upper fixed part should be lifted by jacks or a crane (if available) and deposited upon blocks. After having erected the walls the partition walls and the staircase follow. Then all fixing elements should be fastened to make the whole set-up fully rigid. The next step is the connection of all utilities, the electricity, water, and drainage. After the final adjustment of the walls and corners the furniture can be put in place.

## 4. 5-floor P 5 EDS set-up and other options

Of course the configurations of multi-floor set-ups can be much diversified, regarding both the choice of modules and the overall shape. They can not be joined together without proper planning, design, and in particular without absolutely reliable static calculation, taking into consideration every component part. An interesting option can be offered by using EDS as superstructures for different purposes installed upon existing buildings, e.g. upon blocks of flats. They can carry roofs of all sorts of forms and inclinations major implementation with a number of floors,



**Fig. 4** On a prepared site and an appropriate crane available, allows using an almost paradoxical procedure, beginning with the roof structure suspended from the crane. Then the floors are added from the top to the bottom. The bottom floors can be reinforced by doubling the panels (with a gap or without), depending upon the mass of the upper floors to be carried. Also special frame elements can be used that have been developed for this purpose.



**Fig. 5** Such modular columns can be put together according to the given design

**Fig. 6** Five-storeyed EDS basic block. Ground plan  
12 000×4000 mm

## References

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