

Post Disaster Housing Based on Victims Behaviour and Approach of Architectural Flexibility

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ABSTRACT

Natural disaster is natural phenomena that will bring a lot of loss especially for human life and property. People have to be relocated to the new places because their land cannot be occupied anymore. Many post disaster houses have been offered by big donors. Internasional solidarity automatically rises as sympathy to prevent and ease the burden of victims. Volunteers involved to rebuild victim's dwelling in reconstruction process. Unfortunately many victims did not feel comfortable to live in their new house. Post disaster housing design based only on technical issues, such as quick constructions and low cost. It is likely the causal problems. This paper aims to overcome the problem, that is to design post disaster housing not only considering the technical aspects but also people behaviour and responsive to current climate. It promotes flexible architectural design to offer opportunity for the occupants to fit their personal behaviour on the post disaster housing.

KEY WORDS: Instant House, Architectural Flexibility, Post Disaster Building.

INTRODUCTION

Natural disaster with great magnitude lately happened much more frequent in Indonesia [1] such as: tsunami in Aceh in 2004, earthquake in Nias in 2005, earthquake in Yogyakarta in 2006, then mud volcano in Sidoarjo in 2006. So many assistances help in reconstruction, they brought their own technology and forgot that the people have their own culture and behaviour. Government or non governmental have striven and taken initiative to assist. They made the post disaster house for victims without considering that factors. So, there were such a problem in their post disaster housing that have made they left their post disaster house, such as in Nicaragua which 30% people who occupied post disaster house left their house [2], then in Yogyakarta people of dome house made modification for their post disaster house because it was not suitable with climate and culture [3], also in Sidoarjo mud flow victims rejected to live in occupied house that provided for them in KNV (Kahuripan Nirwana Village) because the environment and spatial behaviour is different with them [4]. During this time, many efforts have been done to construct and rehabilitate the fulfilment housing needs as soon as possible after disaster destroyed one area, but there were many obstacles such as land owned, and the important one is about the design offered by donors or architect [5].

Architecture has to be responsive to human, place, values, leadership structure, and belief [6]. Therefore, when architects start to design, they have to consider the user and their behaviour as well as local character and climate. Behaviour is one way for people to do their roles in an activity system [7]. Although user behaviour and flexibility of this house became the main issues, material is important element that will determine the effectiveness in constructing the house. On the other hand, it should meet today's requirements and its design should make use of new opportunity and materials now available [1]. Flexibility in architecture have a principle that Flexibility is based on the principle that a building can absorb, or adapt to reflect changes in use [8]. Another character of flexibility in this post disaster house is how to create design which is adaptable, transformable and responsive.

Therefore we need an applied, efficient, and easy technology in installation. This post disaster house is to occupy permanently by user and does not become a temporary house. It is able to fulfil the user wants to transform and change its use according to the needs any time. Authors try to give some general criteria to construct the design in specific site, also in humid tropical climate area. This post disaster house will be built in the relocation area that all of the victims impossible to return to their previous site. The area that will be used as a specific location is at Kedung Kampil village, Porong subdistrict, Sidoarjo regency, East Java Indonesia. This relocation area belongs to the victims of mud Volcano in Porong Sidoarjo.

MATERIALS AND METHODS

Study area description

Indonesia has high of seismic level in the world. It is 10 times higher than from seismic level in United States [9]. The specific case in Porong, Sidoarjo the mud volcano is caused of the earthquake chain in Indonesia

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that becomes a trigger to this mud volcano in East Java [10]. Relocation becomes one last choice because the site meets the requirements of site that have to be relocated. Relocation is allowed during the following situation; 1) when the old location is subject to a natural hazard, 2) when the old location is completely destroyed and to move the debris and to make new plotting in the old settlements is inconvenient for rapid recovery and housing purposes. When there was a chance to relocate the settlement to land which belongs to the government since it is generally preferred not to have to pay for the land [11].

Sidoarjo is a town bordered by Surabaya that has an area of 634.89km². It becomes the smallest regency in East Java, It is located between 112,5° and 112,9° east longitude and 7,3° and 7,5° south latitude. Since may 2006, many Porong people were displaced due to hot mud flowing from natural gas well. It has made people in more than three villages displaced and forced to move from their home land because their land have been destroyed by mud flow. One of the impacted villages is Reno Kenongo, this village becomes ground zero because nothing has left and all of the village parts have gone. Reno Kenongo people rejected to stay at relocation place prepared by the government. They decide to move in to Kedung Kampil village as their place to relocate. This relocation is well known as the independent relocation. They choose their own place because they want to reunite with their neighbourhood and spend their compensation from lapindo brantas to build post disaster housing in Kedung kampil Village constructed by Indonesia Real Estate of East java (REI East Java).

The relocation place of Renokenongo Village is located not too far from the main road with good enough road infrastructure. There were local transportation in this area but it does not reach the relocation place. The former function of this place is for sugar cane field. Now, it is becoming post disaster housing for the disaster victims.

Evaluation criteria for architectural flexibility and human behaviour of Kedung Kampil Village

The concept of flexibility creates a building which is not a fixed entity, but a plumpst on which can be inscribed any life style and life view. The user was able to make more significant physical changes at interaction but the architect still defined the character of the building [8]. Adaptable, transformable and responsive become main requirements of flexibility that have to be applied in this post-disaster house. Flexibility has multiple level that will determine how flexible could be implemented, and level of flexibility could be explained in the following [12]

- Initial flexibility or choice in design stage for typological variety.
- In built flexibility as an opportunity for adaptability of the dwelling unit, independent until may be adapted independently from other units and independently from building infrastructure.
- Full potential flexibility for full potential of dwelling for constant change, flexibility of support for the adaptability of the detachable unit and dwelling unit's transformation according to user preferences it allows building to accommodate to new functions, even to change completely the principal use, to be dismantled and relocated.
- Permanent flexibility in multifamily housing overtimes differs.

On the other hand, flexibility is started from the lowest flexible capability and the most high capability to be flexible. Flexibility also have spatial changes that could be categorized in four types[12]:

- Extendibility (enlargement of the space)
- Partitioning (rearrangement of unit's space)
- Multifunctionality (rearrangement within space unit)
- Functional mitation (mutation from one function to another)

Structure of post disaster house have to be capable to facilitate spatial changes also could support flexibility in the construction period. Flexible structure is a structure composition that gives ability for building components to be easily replaced, displaced, reconfigured, reused and recycled. Those structures have some indicators as follow:

- Accessibility
- Replaceability
- Reconfiguring
- Separation

Structure components from flexible building made in factory or assamled at one place and then bring it to the location.

Post disaster house need to consider behavioural and psychological condition of victims, because this house will have several activities as a house is used to be, such as: bathing, washing, cooking, sleeping and gathering with family. Flexibility in architecture could be divided into four types[13] it is used to accomodate user needs:

- Extention flexibility refers to extension and retrofit in architecture. This involves analysing and classifying the positioning and structural properties of extension and retrofit systems.

- Internal flexibility defines the adaptability of a building: In which degree are modifications within an existing structure possible. What are the risks and time requirements? How does the extension influence the building?
- Using flexibility analyses building flexibility in relation to how it reacts to change of use. Concepts concerning the reversibility of changes and the future mono or multi-use are also considered.
- Planning flexibility refers to characteristics which determine whether and how a building reacts during the entire planning and construction phase. It also investigates which measures can be implemented during the planning phase in order to facilitate flexibility during a building's operation time, with the least possible cost and effort.

Although post disaster house have many limitation in space size and spatial configuration as well, user's behaviour is very important to consider and include it in its design. Environmental-behaviour study in architecture is a contemporary approach to the traditional humanistic purpose of architecture. It is a view of design and environment which places the values, needs and preferences of users at the forefront of the design process [14].

The fundamental process of human behaviour could be explained for designing one object we have to look covert and overt information from the subject, which is users. Perception must be done by architect to know about user's needs and behaviour, which is as a response and needs of users. Culture was too abstract a concept and recommended that it had to be broken down into more tangible variables, such as: activities which can be observed, analysed, interpreted and also evaluated [15]. User's behaviour at Kedung Kampil village will be identified how user's activity and used their rooms and its function in spatial order. Besides, how do the changes they have made and house enhancing from the standard form till have various shapes. It will be made as guidance to arrange new concept in flexible design.

There are two main important parts that will be constructed of this house. Firstly, structural frame work that gives any shaped, and another one is wall shaped that gives any variations wall typology according to the functions it needs. On the other hand, the materials used have to be suitable with anthropometric and ergonomic of humans [16]. The frame work systems could be used steel. It is considered as one material could be used in modular system because it has some beneficiaries, like: structure made from its component is more economical and non combustible material. It is fast in installation and resistant to termite. In addition, it could hardly swell in high temperature and neither could shrink in cold temperature [17]. Besides, the wall typologies could be used materials that have an easy modified and distributed, for example: Calcium silicate and plywood. It has great character to be wall partition inside or outside. The materials also have many variation and easy to get if occasionally this component need to be replaced.

Methodology that used during design process is creative leaps. In this method, designing have to concern with Setting Design Objective, Developing design and Evaluation Criteria, Evaluation of existing systems, Fragmental Alternatives, and best existing system [18]. Therefore, analysis of user behaviour have to do to get data of their spatial behaviour and their preferences to make any changes whether additional or removal of their house component. Observation used to collect overt behaviour such as physical and physiological and visible behaviour because through observation the researcher could learn the behaviour and the meaning attached to that behaviour [19].

RESULTS AND DISCUSSION

General criteria

Based on the elaboration of the references, precedent, and field observation in Kedung Kampil Village Sidoarjo, then collaborated in one conclusion that suitable for particular case in Kedung Kampil Village Sidoarjo for post disaster housing criteria as follow:

- In spatial flexibility, flexibility applied to the related spatial function and enable to change or adapt to one each others as well by making a connection in related room in order to give capability for the room to be merged, then partitioning of indoor room could be created by using moveable partition, possibilities of reconfiguration from original lay out to give functional mutation ability.
- From the variety of functions in the same space, it has to be broken down in to several modules room that each modules has a multiple function with several conditions followed. This house has to be planned for upgradeable construction to response the spatial changing and have to be responsive with climate.
- Modules will be divided in to four types, firstly, main modul which consists of several functions and belongs to the multiuse and multipurpose modules. Secondly, module unit 1 that accomodates multipurpose functions, and thirdly, module unit 2 that is smaller than module unit 1 and it could be used if the people want to develop their house in small part. The last one is bathroom module, it has a single function with smallest sized among another ones.

- According to the analysis of sample, the development of post disaster house in the relocation site, generally grows to the back side while there are some houses grow in front. and there are several rooms that always exist, for example, living room with conducted several functions of activities, bed room, and bathroom. Each room has several function although it is recognized in one room's name.

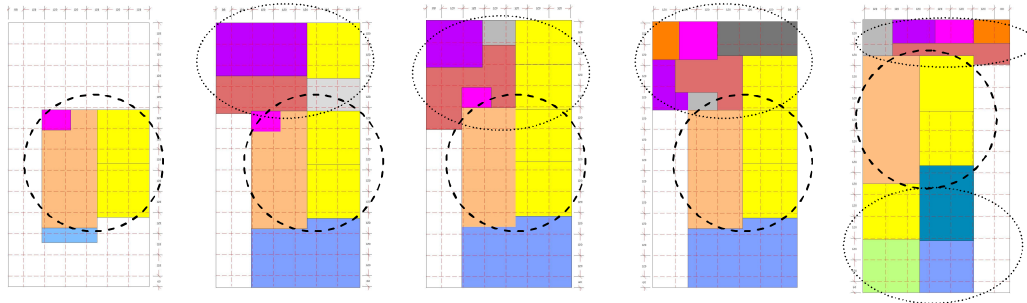


Figure 1 : Changing Analysis of Post Disaster Housing in Kedung Kampil Village Sidoarjo

This post disaster house learning from the evidence[20]. It means the design could be based on the social phenomena that found in field and several guidances about particular case then analysed and applied in to the design. The general criteria will be worked for flexibility design in object along with its boundary is as post disaster house, if the changing is more than the expectation or more like what have found in analyses based on the sample above, it may not be worked out, and supposed to be beyond of post disaster boundaries.

Strategy Approach

In line with all of the general criteria and according to the developing post disaster house in the study area that determined by user's behaviour, it could be made any arrangement to become space configuration of this post disaster housing as follows:

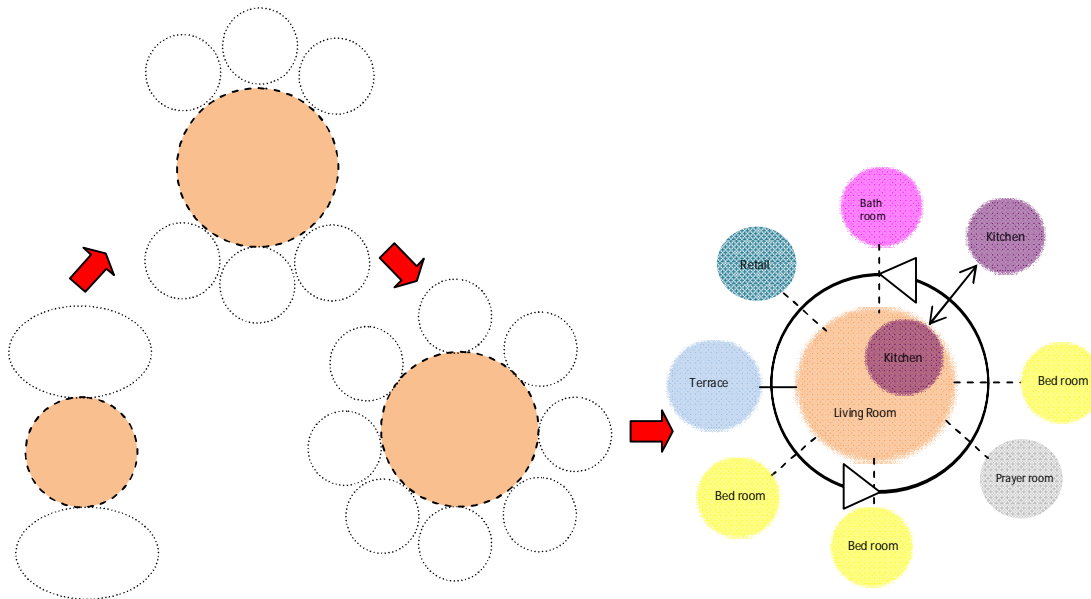


Figure 2 : Space Programming Based on The Changing Analysis of Post Disaster House

The pattern of space configuration above is based on the analysis of post disaster house development in Kedung kampil Village Sidoarjo. The orange big circle is the main space that becomes centre from additional room around of it, the main space will become multipurpose and multiuse module, and the additional room will be another module that has a capability to join with the main module. The arrangement in that module could be made and will take boundaries according to the family structures that implied in room amount and lot size. It has 15m x 8m, to make easy configuration in modules order, it is helped by grid lines in 120cm x 120cm as a modul sized according to the size of material selected. All of the modules will be arranged and fixed in to the site in area study.

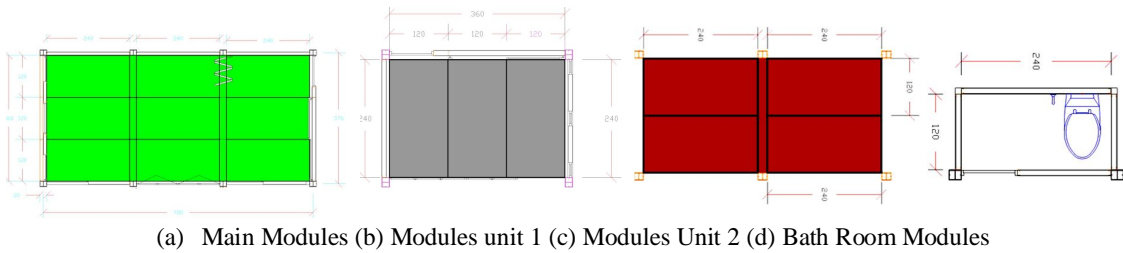


Figure 3 : Modules Unit of Post Disaster House Design

Modules is space configurations that will join together creating one unit of post disaster housing. All of the modules have basic sized element. It is 120cm x 240cm and enhancing becomes every size of modules according to the compromised with existing size of room at the site study area.

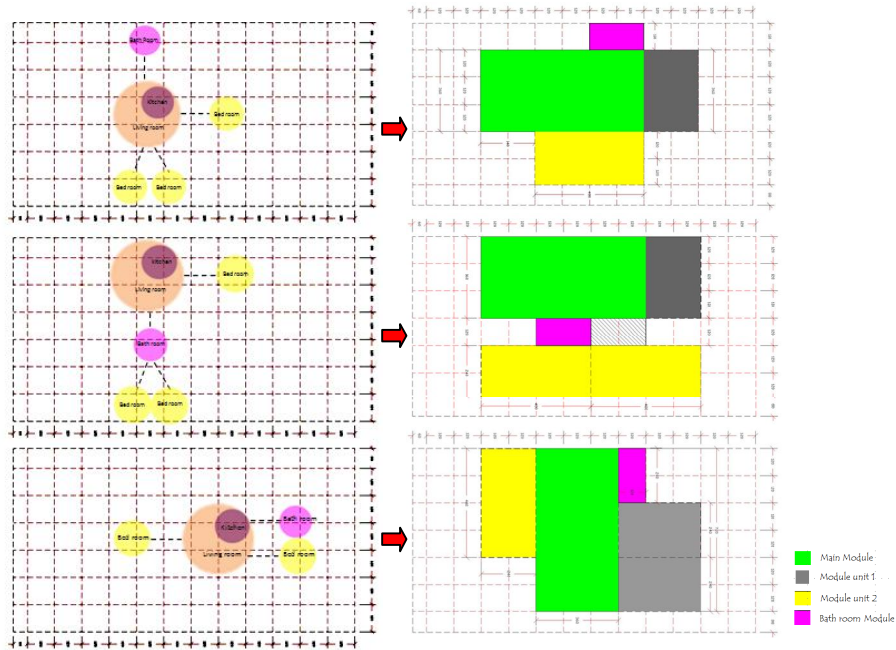


Figure 4 : Space Program Application in Site and Space Configuration

From the whole space configuration, it could be broken down in several space configuration that refers to the post disaster layout plan. The layout plan arranged by the modules in to one configuration and enable to upgrade until 2 stories. In order to make easy upgrade and transform the development of this post disaster design easy upgrade and transformed in regular orders. All of the additional modules parts have to be planned in one structure frame work orders, so that every additional modules cannot add freely but it has boundaries in structural frame work and lot size.

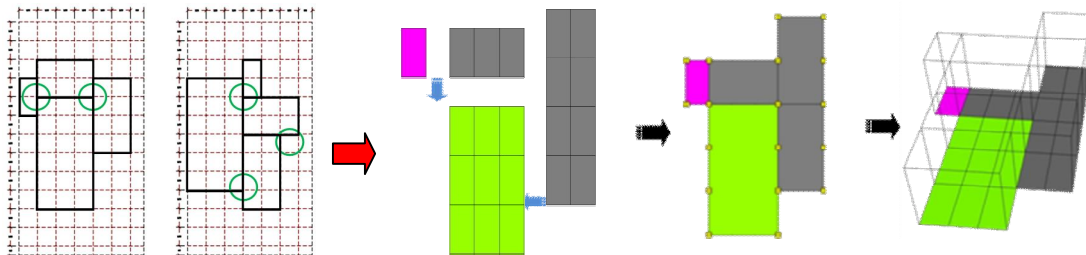


Figure 5 : Key of Space configuration

The left picture is not allowed configuration because the additional modules is not in line with structure frame work and caused unproductive spaces the green circle is mark for unproductive space and creating useless

corners. The right picture is allowed configuration because it match with structure frame work and none uneffective spaces found. Principally, this module could be arranged in many configurational orders as long as that arragement followed the structural orders and particular site boundaries.

After this composition complete, gaining the house become responsive to humid tropical climate need to be accomplished with roofing elements and walls with opening systems. Roof elements is another part of this modules, so it will be installed independently to the house and modified in efficient size in then it could be modularized although separated from modules unit.

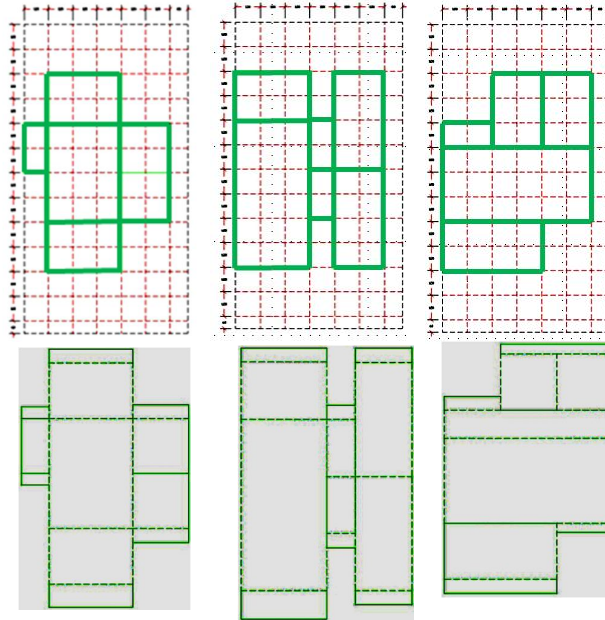


Figure 6 : Roof plan for each house configuration plan

Roof elements is modified by considering the layout plan, although it is separated from modules but it is compromising with layout that will make this roof able to modularized to get effective roof design. It will make this roof more effective and able to do its function to overcome heating and rain falls water.

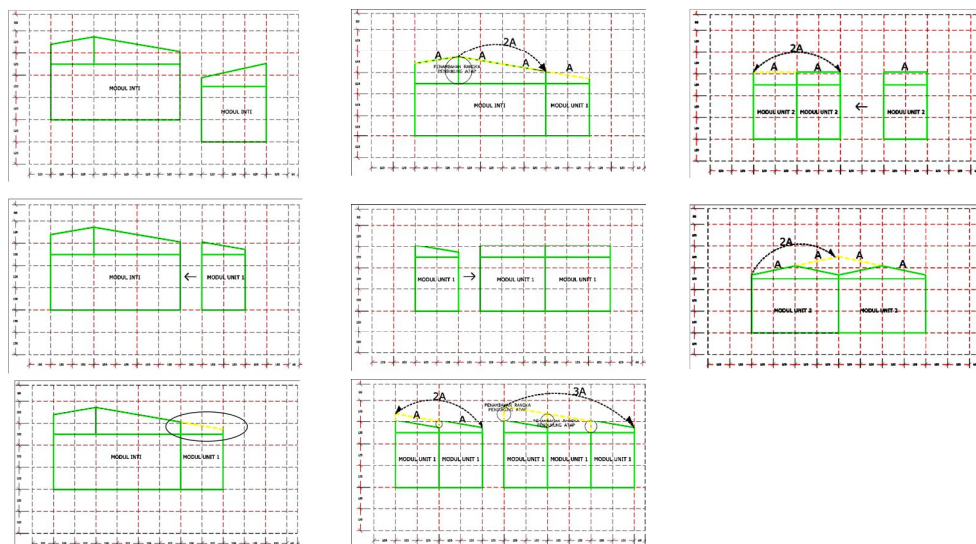


Figure 7 : Roofs Principal Configuration

From the left to the right is roof principal configuration for main modul, it is module unit 1. Then only unit module one and next to that module followed by only module unit 1 roof configuration. And the last one is

unit module 2. The roof composition has to be the second round size from the beginning size, if roof wide in module 1 is A, so the roof for main module must be 2A or A, and another modules either.

CONCLUSION

There are several problems at post disaster housing, such as: functional changing and physical changing, even left from post disaster house, all of that problem due to the design did not see what victims behaviour and only concern in technical issues. It needs to overcome in order to post disaster housing could fulfil the victims need, and ease their burden. This design made based on behavioural and preferences from the victims and approach of architectural flexibility. The strength of this design is the part of the house element consists of modules that can be joined with other modules to create a whole post disaster house. This modules is multiuse and multifunction, it has many configurational orders according to the users want. This house also enable to detach in structural and spatial configurational changing. To get adapted with local climate in Kedung Kampil village, roof is important element that have to be added in this house configuration. This design have an opportunity to enhance and have a lot of configurational pattern, but it has to be based on the research of another particular case.

Roof is installed independently from modules, and in order to be effective the sized and configurations is compromised with layout plan of the post disaster house. Although this design enable to be open planned but it cannot avoid standing column in its configuration. Although this house have a chance for a lot of configurational pattern but the installation have to fulfil the boundaries requirements and the particular site, so that it makes boundaries for flexibility in this design.

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