Low-cost housing with sustainable building materials for Vietnam; using recycled plastic and rice husks

Dr. Ir. Jan Bredenoord, PUM Netherlands Senior Experts, The Hague, Netherlands.
Arch. Vuong Le Nguyen The, Ho Chi Minh City, Vietnam

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The materials described in this document are patented by Trong Danh Corporation, Ho Chi Minh City, Vietnam, according to Vietnamese legislation.
Introduction

In this document a description is given of an innovative building system which includes new building materials and an adapted construction technique. As basic raw materials, two products are used: 1) recycled plastic in the form of polypropylene, and 2) rice husks (or hulls) which is the waste of rice cultivation. The building materials can be manufactured sustainably and create hardly any pollution or CO2 emissions. Rice husks are the hard protective coverings of grains of rice. After they have protected the rice during the growing season, rice husks can be put to use as a building material, insulation material, or bio-fuel. In Vietnam the rice husks are usually burned in the open air – or just are thrown away in rivers – which has negative environmental consequences. The use of recycled plastic and rice husks for building materials has clear environmental benefits in Vietnam, especially compared with traditional building materials such as bricks, building blocks of concrete, and concrete and terracotta roof tiles.

The new building materials which are known as Rice Husks Polypropylene (RHPP) can have many uses in the construction industry. In this document we want to limit ourselves to their application in low-cost housing. There is still a lot of housing demand in Vietnam by low- and lower-middle-income groups. The use of the new building material RHPP and the related building techniques can help create low-cost housing. Thus these new materials and building systems can be used to develop affordable and social housing. The houses can be constructed at the edge of existing cities as well as in villages and small towns in rural areas. The new building materials could also be applied in urban areas where large-scale house construction is occurring, but they are not suitable for high-rise buildings.

In this brochure we will first describe the new building materials and their constructive aspects. Then examples will be provided regarding their practical applications and possibilities for the future.

1 Description of the building materials

The raw materials are used to create two building materials: RHPP building blocks and roof tiles. RHPP is used to construct houses supported by a foundation and a steel framework. The materials are produced in Ho Chi Minh City by Trong Danh Co. The components of these TD building materials are rice husks, polypropylene plastic, baking powder, catalyst, and other additives. The latter components help to increase the adhesion of the rice husks and the plastic. The resulting material is resistant to fire and provides heat insulation and sound insulation. Moreover, it is waterproof and lightweight, which reduces transport costs and makes it easy to handle the materials during the construction.

RHPP is produced in specially designed machines that perform all of the necessary operations, namely mixing the raw materials, heating them, mixing them again and finally pressing the end products.
Ingredients of building materials (left) and production machinery (right)

Storage of building blocks (left) and roof tiles in selling point (right)

2 Constructive aspects

Constructions using RHPP materials weigh much less than traditional building materials, and thus the constructive frame does not need to support much weight. This significantly reduces the final construction costs. Before the building of the frames and the walls begins, a good foundation with a cement floor must be built. The framework must then be anchored in the cement floor.

The roof construction is traditional, but the roof may be lighter in weight because the roof tiles are relatively light. Thus, the roof tiles must be screwed onto the metal framework. The entire construction should be able to withstand tropical storms. The construction system is suitable for single family homes (ground floor), and possibly for homes with an additional (second) story. Before it can bear the a second story, the framework must be strengthened.
The combined building system is structurally suitable for the following housing types:
- Single family homes, eventually with an additional story
- Recreation or vacation homes in resorts
- Small dwellings for starting households that can be expanded by the owners in a later phase
- Social housing projects supported or organized by the government or private parties
- Dwellings that must be built quickly in disaster areas
- Houses in villages and small cities in rural areas
- Floating homes for areas that tend to flood (concept still under development)

The execution of the construction will be done by a team of experienced construction workers who are used to working with residents. The construction system is very suitable for working in cooperation with a local community or a group of families who want to build their dwellings jointly (sometimes as housing co-operatives). The households can even provide a part of the labor for the purpose of lowering the construction costs. The construction of the homes should be done under good technical guidance, which can be delivered by Trong Danh and others.

3 Practical applications of TD building materials

Model house 3 x 8 m. Surface 24 m². Two bedrooms, one bathroom.

Small family home (model house) width 6 m. depth 6 m. (or longer). Living room, kitchen, two bedrooms. Surface of model shown 64 m² (including upper floor).
Houses in villages and small cities in rural areas
Vinh Thanh Community House and small family homes
Location: Soc Trang Province, Vietnam. This project was realized in 2014 with the help of the Australian Foundation for the Peoples of Asia and the Pacific (AFAP).

Floating homes for areas that tend to flood
Concept still in development.
4 Possibilities for the future

The new building materials and the light building construction techniques are still being developed. There are many opportunities for further development, especially in the areas of social housing and low-cost housing in rural villages.

With RHPP, houses can be built quickly in areas affected by natural disasters. The development of floating homes for delta regions is another possibility.

All of this demands development funding and collaborations among technological institutes and private and public parties. RHPP technology makes the development of a broad housing typology for affordable and sustainable housing possible.

In addition, development of the basic raw material is probable. For instance, scientists could investigate whether polypropylene could be replaced by bio plastics, to create an entirely biological material that is suitable for housing.

The ‘TD Housing concept’ as described in this brochure is suitable for using in earthquake areas too. The concept will be clarified in technical terms – inclusive test results – by Trong Danh Co. and the architect (contact information is given below).

Contact information:
mailto:trongdanhcompany@gmail.com / www.trongdanh.com.vn

Arch. Vuong Le Nguyen The, Ho Chi Minh City, Vietnam / thevuong.le@gmail.com