Galvalume Concrete Composite Panel Puzzel with Iron Reinforcement

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Abstract

Cold Formed Steel is one component that is often used by the public as a building structure (C Profile). This is because Cold Formed Steel is easy to work with, easily available on the market and relatively inexpensive. Mild steel profile C can be used as a substitute for roof trusses made of wood and concrete. Research on concrete panels made of C Galvalume with a series of iron reinforcement / wiremesh with a diameter of 6 mm. This panel test is carried out only at the concrete compressive strength test stage. This is done to determine the bearing capacity of the panel against the maximum pressure above it. Panel test objects as many as 3 pieces at the age of 14 days. The results of the concrete panel test show the results of 7.000 kg/cm^2, 8.000 kg/cm^2 and 7.800 kg/cm^2. Based on these results, it shows that composite concrete panels can be used as part of simple building structures.

Keywords

Test of concrete panels, composites, C galvalume, compressive strength

1. Introduction

Galvalume is a mild steel material that is processed by anti-rust coating using aluminum. This means that the Mild Steel Material which is still a rolled sheet/coil is dipped in molten/hot aluminum continuously (continuous hot dipped process) with a coating composition of 55% Aluminum, Zinc/zinc which also functions as anti-rust 45% and other materials up to 100 %. The high content of Aluminum in Galvalume makes it more resistant to rust.

The use of galvalume as a structural part in the form of a concrete composite has not been widely used in simple housework. The advantages of galvalum really support the ease of making houses, especially in the form of puzzle panels. The use of galvalum will increase the ability of people who have little expertise to build the desired small house easily. The use of galvalume as a part of composite concrete can be weathered in a precast manner so that it is environmentally friendly. So far, there have been various construction methods, the most popular of which is the RISHA panel house method. The RISHA house is very easy to do and apply in addition to other methods. [3] The Risha system can encourage the development of medium-sized industries and even home industries that have the potential to create new jobs. The Risha system can also help accelerate the development and provision of national housing because technically this system has an advantage in terms of construction time (if the required conditions are met). Cost and resource or capital efficiency can be achieved with this system because material waste can be minimized because the prototype of the Risha system has referred to the principles of modular coordination and industrialization of components. This system can provide material benefits and social benefits for the community. Disassembling and reassembling houses can be done easily by the community. In addition, they can also develop their house towards the vertical. Development work in the field does not require a large number of workers because it is sufficient to assemble the components into buildings. Armed with the RISHA method, research was carried out on concrete panel structures that allow them to be more easily applied in the construction of small/simple houses.

The purpose of this research is to make precast composite concrete panels in which there is a galvalum box frame as a wiremesh iron binder as a strength of composite concrete structures as a condition for building a decent house. The concrete panels can be joined together like a puzzle to form a stronger whole. Another goal is how strong the use of galvalume as a composite concrete material is in terms of the compressive strength of the concrete it can carry.
The methodology used is to make a Galvalum composite concrete prototype that can be assembled and used in the construction of small-scale houses. The use of concrete materials with various variations is still used which is the most widely used building material in the world. The design of a series of Galvalume Frame Composite Concrete Panels using precast concrete used in the structure of a building.

2. Literature Review

The RISHA module was developed to answer the public's need for general information about Instant and Knock Down technology. RISHA is a technology that was studied and researched by the Research and Development Center for Settlements in the 2004 fiscal year, and was launched on the market on December 20, 2004. RISHA stands for Simple Instant House which was developed by the Center for Research and Development of Settlements of the Ministry of Public Works which owns a patent. Rishaini uses knock down or disassemble construction technology and to assemble one Risha house it only takes 8 hours. This technology has been tested on a large scale during construction during the handling of housing for earthquake and tsunami victims in Nanggroe Aceh Darussalam and Nias. Currently, RISHA has become a standard part in handling housing needs during disaster conditions and for commercial use. This

development is also supported by vendor skills that have been trained by the Research and Development Center so that RISHA becomes part of the housing development business in Indonesia. Large government-owned companies have also made RISHA modules on a large scale. Production is carried out in production factories with sufficient capacity to build thousands of small and medium scale houses. PT Waskita Beton PraPrint and PT WIKA Beton and Gedung have developed RISHA on a large scale as shown in the Figure 1

Figure 1. RISHA Manufacturing

Apart from that, in the implementation of RISHA construction, it can also be combined with local materials such as the use of bamboo as walls and roofs of buildings, as shown below in Figure 2:

Figure 2 Combination of RISHA with Bamboo material

In the research conducted by UTHM Malaysia civil engineering lecturers regarding the use of galvalume-based composite concrete, it has also been carried out as shown below in Figure 3:

Figure 3. Research by UTHM lecturers

In addition, it is also necessary to use supporting materials for the manufacture of composite concrete. The use of suitable materials to make the composite light and strong. One of the innovations made by the Indonesian government

company engaged in the electricity sector is by utilizing coal waste, namely fly ash and bottom ash (FABA) for the manufacture of building wall panels. The use of FABA also saves the cement material used at a cost of up to 30 percent. One of the saving factors is the use of conventional building materials requiring as many as 10 sacks of cement, with Faba materials requiring 4 sacks, you can see the image of the material using FABA (Figure 4):

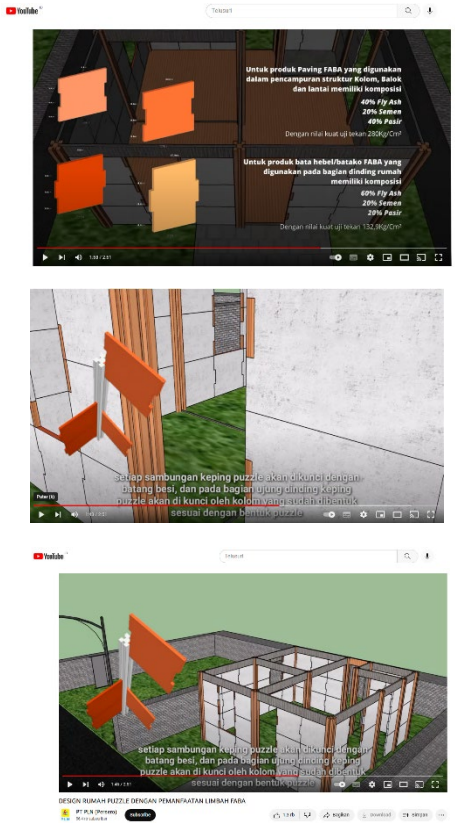

Figure 4 Use of FABA for house construction

At the placement and meeting of precast concrete joints must be in clean condition so that when casting is carried out good quality concrete is produced and protected from other materials that affect strength (Figure 5).

Figure 5. Precast joint placement

Beberapa peneliti juga melalukan kajian tentang efek gempa pada sambungan pracetakm seperti dilakukan Jansevteen Siburian, 2018, analyze the reliability structure of modular houses earthquake-resistant and to compare the results of full-scale testing at RISHA House in the laboratory with SAP2000 program. By using secondary data from the laboratory, the results of this research is value of the melting point at the test load conditions given burden left load are 33,37 % difference on default SAP 2000 and 3,57 % difference on manual SAP 2000. on the test object in the given conditions right load are 26,71 % difference on default SAP2000 and 13,93 % difference on manual SAP 2000. The differences of the test results caused by the specimen from laboratory is at the less than ideal field conditions because of an error in the installation of the test specimen that causes less precise pedestal so that the primary function of the foundation is not optimal.

Leonardus SBW, 2011, making a simple earthquake-resistant residential module with a precast system. This matter carried out to facilitate the Government and the community in rebuilding proper housing in a short time, especially for the victims of the earthquake. The specific objective of this study was to determine the behavior of precast concrete beam joints in accordance with previous studies. Connections are a very important element in design and earthquake resistant building construction. Beam modeling for a 1-storey building uses beam dimensions of 15x15 with 4Ø10 flexural reinforcement and Ø10-50 mm shear reinforcement, while for modeling beams for 2-storey building beam dimensions 15x20 with 6D13 flexural reinforcement and Ø10-50 mm shear reinforcement are used. . The length of the test object beam is 150 cm. The results obtained from this study, for the 15x15 beam, a good ductility value was obtained, while for the 15x20 beam there was failure at the welded joint (Figure 6)

Figure 6. Testing of precast beams

In the research conducted by civil engineering lecturers at Narotama University with the Polinema - Brawijaya research collaboration regarding the use of galvalume-based composite concrete, it can be seen in the Figure 7 below:

Figure 7. Implementation of composite panel houses in Semen Village, Gandusari District, Blitar City

3. Methods

The methodology used is to make a Galvalum composite concrete prototype that can be assembled and used in the construction of small-scale houses. The use of concrete material with quality K175 (fc' 14.53 Mpa) is the easiest to do. The materials used for the manufacture of galvalum composite concrete panels consist of channel C galvalum, iron diameter 6, panel formwork and concrete mix. Material testing was carried out in several laboratories, namely at Narotama University, Surakarta Sebelas Maret University, UNIVET Surakarta and Malang State Polytechnic (Polinema) (Figure 8).

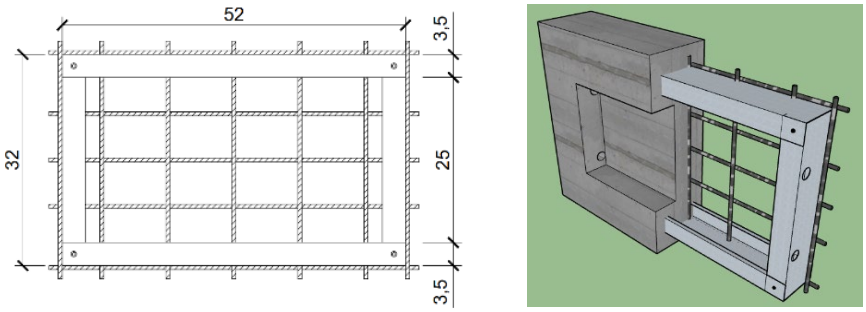

Figure 8. Galvalume Concrete Composite Panel Puzzel Design

4. Results and Discussion

Mix Design and Aggregate Characteristic Tests

Table 1. Recapitulation of Fine Aggregate Test Results

SIEVE		STAY ON THE SIEVE		% CUMULATIVE	
NUMBER	mm	gram	%	Stay	Through
4	4,76	34	8,01%	8,01%	91,99%
8	2,38	40	9,43%	17,45%	82,55%
16	1,19	79	18,63%	36,05%	63,9%
30	0,59	102	24,05%	60,14%	39,85%
50	0,297	82	19,33%	79,48%	20,52%
100	0,149	63	14,85%	94,34%	5,67%
Pan	0	22	5,18%	100%	0
Cumulative					
	Fm sand = 424				

Table 2. Recapitulation of Coarse Aggregate Test Results

TESTS	UNIT	RESULTS	SPEC INTERVAL	Results
Dampness of broken stone	%	0,01%	Max. 2%	Fulfill
Absorption of crushed stone against water	%	2,6%		Fulfill
The volume weight of crushed stone				
1. With poke	gr/cm^3	1,49	1,4 – 1,9	Fulfill
2. Without poke	gr/cm^3	1,43	1,4 – 1,9	Fulfill
Cleanliness of crushed stone against mud	%	0,2%	Max. 2%	Fulfill
Specific Gravity of Crushed Stone	gr/cm^2	2,22		Fulfill

Aggregate Combined Gradation

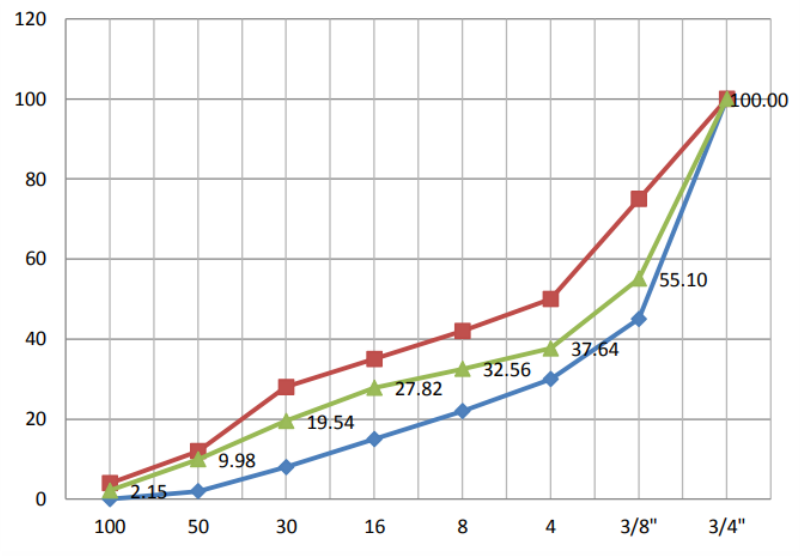

Figure 9. Aggregate combined gradation graph

Limit Y1 (Blue) , Limit Y2 ((red), Green Average (Table 1- Table 3, Figure 9).

Slump Test

To find out the level of viscosity of the concrete mix, a slump test was carried out. It was noted average of 12,3 cm.

Concrete Unit Weight

Checking the concrete unit weight is carried out when the concrete is 14 days old and testing the unit weight of concrete is known that each type of concrete is made of three pieces (Table 3).

Table 3. Concrete Unit Weight

No.	Concrete Type	Module Type	Weight (Kg)
1.	Galvalume Concrete Composite Panel Puzzel	A	58.4 kg
		B	58.8 kg
		C	60.5 kg

As we can see from the table 3 , there are differences in weight value. It might be the case of the weather, temperature and air humidity surrounding the tested modules during those 14 days.

Concrete Compressive Strength

The 1000 KN compressive Strength unit test was used to test the designed modules. The result was as shows in Table 4.

Table 4. The concrete compressive strength result

No	Sampling Galvalume Concrete Puzzle Panel	Compressive Strength kg/cm^2	Avaerage Compressive Strength
1	A	7,000	7,600
2	B	8,000	
3	C	7,800	

The results of the concrete panel test show the results of 7.000 kg/cm^2, 8.000 kg/cm^2 and 7.800 kg/cm^2 (Figure 10-Figure 12).

Figure 10. Compressive Strength Test of Concrete Puzzle Panel

Figure 11. Implementation of the Concrete Puzzle Panel Prototype

Figure 12. Implementation of the Concrete Puzzle Panel Prototype

5. Conclusion

The results of the concrete panel test show the results of 7.000 kg/cm^2, 8.000 kg/cm^2 and 7.800 kg/cm^2. Based on these results, it shows that composite concrete panels can be used as part of simple building structures.

In addition, the sand test obtained results for sand humidity of 0.77%, sand absorption in water of 17.9%, the volume weight of sand without a joist was 1.56 gr/cm3, with a vibration of 1.76 gr/cm3, with a vibration of 1.71 gr /cm3, cleanliness of sand against mud 2.6%. Coarse aggregate test results found that the humidity of crushed stone was 0.01%, the absorption of crushed stone to water was 2.6%, the volume weight of crushed stone without being jostled was 1.49 gr/cm3, with joist gr/cm3, the cleanliness of crushed stone against silt 0.2%, crushed stone specific gravity 2.22%. The sand used is from the sand of Lumajang City which is adjacent to Mount Semeru

The recommendation that can be given is that when implementing concrete puzzles in the field, skilled workers are needed and understand the world of construction techniques so that basic training needs to be held first in making galvalum composite panel concrete.

Galvalume composite concrete panels are a relatively recent innovation, so the precision and design of the panels is not yet precise/accurate. The use of galvalum as a filler in the manufacture of composite concrete panels needs to be proven through a long time test to determine weather resistance and so on.

The advantages are when implementing galvalum composite concrete panels, it can be made outside the field in precast form so that work can be carried out at any time and in a different place from the construction site.
The resulting concrete panels are strong in weight and have been carried out in laboratory tests with good results.
The resulting panel shape is uniform and has relatively the same quality.

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