PROCEEDINGS

The 2nd International Conference on
Sustainable Technology Development

ICSTD Bali 2012

Developing Sustainable Technology for a Better Future

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2nd International Conference on
Sustainable Technology Development
(ICSTD)

"Developing Sustainable Technology for A Better Future"

Bali, October 31st 2012

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"Developing Sustainable Technology for A Better Future"

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Editors:

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PREFACE

This proceedings compiles all papers presented in the 2nd International Conference on Sustainable Technology Development (ICSTD) held at the Udayana University, Bali on 31st October 2012.

Three plenary presentations were delivered by keynote and invited speakers with international reputations from Japan, Germany, Singapore and Indonesia and a total of 78 papers (oral presentation) compiled in this proceedings, which were presented in the conference from thirteen countries (Indonesia, Japan, Australia, India, Korea, Malaysia, Iran, Egypt, Libya, China, Thailand, Sri Lanka and Bangladesh).

We thank those who involve in the organizing committee for their hardworking. While it was a huge task, it was a privilege for us in editing this proceedings and work together with the referees who reviewed papers.

We hope that the papers contained in this proceeding will prove useful in developing further study.

Editors

FOREWORDS-HEAD OF ORGANIZING COMMITTEE

I would like to sincerely thank to all of the authors who contribute their papers in this proceedings. I would therefore give my high appreciation on all of those effort and dedication.

The conference was held by Faculty of Engineering, Udayana University, in relation to the 50th Udayana University Anniversary and in collaboration with International Institute of Management, Energy and Environmental Management, University of Flensburg, Germany. This conference was aimed to gather scientists, academics, engineers and industries in engineering related areas to discuss and share their expertise and ideas in the field of Sustainable Technology Development. The conference theme "**Developing Sustainable Technology for a Better Future**" has appealed participants presenting their studies on four major fields of **Architecture, Civil Engineering, Mechanical Engineering and Electrical Engineering**. This 2nd ICSTD also focused on development of technology to achieve sustainable city. The conference was financially supported by Engineering Faculty of Udayana University and several sponsors.

I hope this International Conference has created an international networking and collaboration and open up new ideas in maintaining world prosperity in all aspects in sustainable development.

I will use this opportunity to invite you again to join us in The 3rd International Conference on which will be held in the year 2014 in conjunction with the anniversary of Udayana University.

Last but not least, I would like to highly appreciate all of the members of the Organizing Committee for the good teamwork to make the 2nd International Conference on Sustainable Technology Development (ICSTD-Bali 2012) possible and the team of editors for the hard work compiling and editing 78 papers presented in this book.

See you again in Bali at 3rd ICSTD 2014

Putu Alit Suthanaya, ST, MEngSc, PhD

FOREWORDS
RECTOR OF UDAYANA UNIVERSITY

I would like to express my great appreciation to the organizing committee who worked so hard to make the 2nd International Conference on Sustainable Technology Development (ICSTD-Bali 2012) to happen smoothly. This conference was held in conjunction to the 50th Anniversary of Udayana University and being our bi-annual agenda. The main aim of this conference was to respond the problems related to the sustainability in a city, i.e. reduction of the city's use of natural resources and production of wastes, while simultaneously improving its livability.

I was so happy to have you all in Bali which is well known in the world as a favorite tourist destination as well as recently a favorite site for holding International events, such as International Conference. As this conference was designed to gather scientists, engineers, practitioners, and industries in Engineering related disciplines, I expected intense discussion has happened among them so that some brilliant ideas to be used to improve the quality of human life in a city have been formulated and published in this proceeding.

Here, I would also like to acknowledge the National and International invited speakers for their willingness to come miles away to Bali and present their high standard papers. I understand that you all spent much time for this conference, and therefore I must give high appreciation on all of those effort and dedication.

I hope this International Conference was an ideal forum for communication and sharing ideas as well as experience in Engineering-related disciplines in the future. I also hope that this forum served as a forum for promoting advanced technological development with regard to economic growth, environment and social welfare.

Finally, I wished you most successful conference and hope that it provided new ideas and strategies for the application of Engineering in all aspect of our life.

See you again in Bali in 2014

Prof. Dr. dr. I Made Bakta, SpPD.(KHOM)
Rector of Udayana University

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Concrete Wall Panel From Styrofoam Waste With Wiremesh Reinforcement

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Abstract: Wall is part of the room divider that influence the structural aspects of weight and rigidity. Based on these reasons we need wall that has some characters such as light but also environmentally friendly. Manufacture of lightweight concrete wall of styrofoam is an effort to utilize waste of styrofoam. Styrofoam concrete wall panel study using specimens measuring length 1000 mm, width 300 mm and 70 mm thick, with the addition of 15 mm thick layer of plaster / mortar on both sides. The composition of 1 m3 styrofoam concrete consisted of 300 kg cement with 0,5 water-cement ratio, 60% styrofoam, and 40 % sand. Testing and research produced the following data : the average of flexural strength specimens without wiremesh : 3,77 MPa. The average flexural strength specimens with wiremesh : 5,84 MPa. The results showed that the strengthening of wiremesh increased the flexural strength of the panel.

Key Words: *utilization of waste styrofoam, wall panel, flexural testing*

1. PREFACE

Concrete is a material that commonly used in building structure. Most of the current building using concrete as its main component. This is not surprising because concrete has advantages when compared with other materials, like wood and steel. Some concrete advantages are relatively cheap, has high compressive strength, resistance to corrosion, relatively simple in construction, and relatively resistant to fire. However, concrete density is high enough so that influence the dead load on a structure.

Concrete is a building material created by the mixing of coarse aggregate (gravel), fine aggregate (sand), portland cement, and water, which is hard as a rock. This type of building material called concrete with normal weight range 2400 kg/m^3, a relatively heavy weight for buildings with concrete structure. To reduce the dead weight of a structure using concrete materials, much has been done, including the use of alternative building materials in the form of lightweight concrete (Tjokrodimuljo, 2007).

In a house or a building, the weight of brick wall can reach 250kg/m^2, while the concrete weight could reach 2400kg/m^3. If the total, will reach tens or hundreds of tons of even more, depending on the height and building area. if an earthquake happens, each will have a mass movement or displacement. The higher the building, the greater mass movements. Therefore, the selection and use of building materials that have a lighter weight, are expected to reduce the effects of earthquakes on buildings.

In the SMARTek journal 2011, Ramadhani describe some of the lightweight concrete definition quote from Dobrowolski, Neville and Brooks, Murdock. Dobrowolski in Ramadhani (2011) explains that the lightweight concrete is concrete with weight below 1900 kg/m^3, it is lower than weight of normal concrete. while Neville and Brooks providing

concrete limits light weight concrete under 1800 kg/m^3. According to Murdock, light weight concrete volume ranged from 1360 to 1840 kg/m^3 and the weight per volume to 1850 kg/m^3 regarded as the the limit of the concrete lightweight, although this value are sometimes exceeded.

This study is intended to use styrofoam waste as a replacement for coarse aggregate in lightweight concrete is applied to the manufacture of wall panels, and then try to increase the flexural strength by providing a layer of ø 3 mm wire mesh and plaster (mortar) on the outside. As we all know, Styrofoam has quite light weight. Therefore, the basis of these considerations is expected that the resulting wall panels will be lighter and yet still has the power equivalent to the strength of the wall in general.

This study uses assumptions and limitations are as follows: The amount of styrofoam used as a lightweight concrete mix is 60%: 40% sand, with a cement content of 300 kg/m^3. Type of cement used Portland Composite Cement (PCC). The initial planning value of water cement ratio is set at 0.5. Styrofoam is in use is that the styrofoam waste shaved/crushed by using a chopper, and in dry conditions at the time of blending/mixing concrete. Fine aggregate (sand) taken from the river Progo, Yogyakarta. Thick styrofoam lightweight concrete panel set 7 cm. Wiremesh pattern used is a form of grid size 50x50 mm, 3 mm diameter reinforcement. Variation distance between the layers of wiremesh connector wire is 15 cm, 25 cm and 35 cm. On the 15 mm thick outer layer of the composite wall panels used a mixture of cement and sand (mortar) with a ratio of 1pc: 2Ps, with a w/c ratio value determined at the initial planning is 0.5. Test specimen wall panel is restricted to the bending behavior of the wall panel

2. METHODE

The research was carried out by experimenting/testing in the laboratory. The experiment was conducted with the following stages: Preparing materials and tools to be used, examination of the base material (sand, cement, water, styrofoam, wiremesh), preparing and making the test specimens, treatment/curing test specimens, testing the specimens, and then analyze and discussion the test results. To carry out experiment, the basic ingredients needed are: sand, cement, styrofoam waste, water, wiremesh, connector. In order for testing, both for measuring the compressive strength and flexural strength, is used compression testing machine.

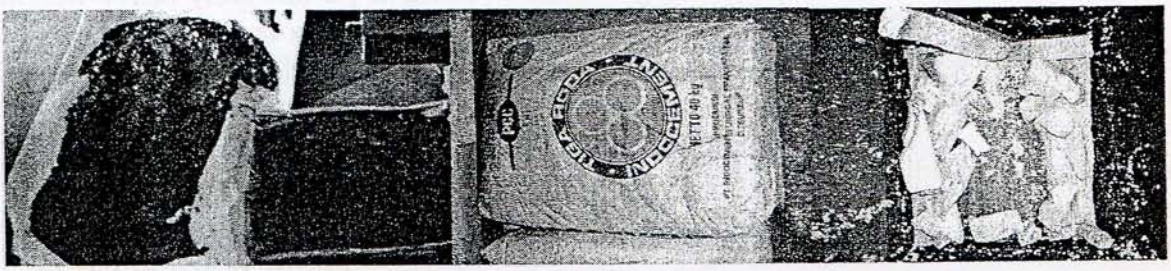


Figure 1 basic ingredients: sand, cement, styrofoam waste

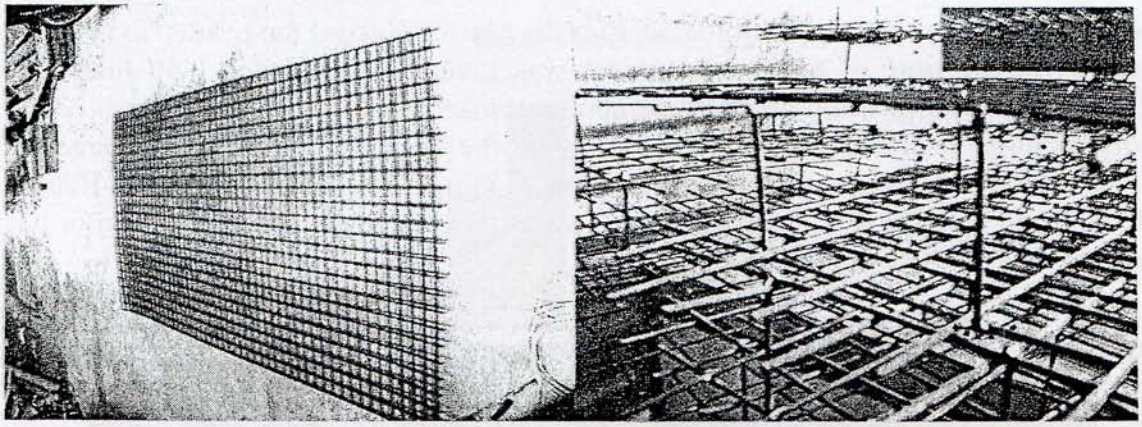


Figure 2 wiremesh and connector

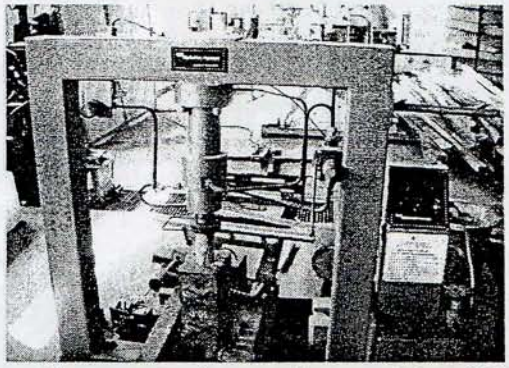


Figure 3 compression testing machine (CTM)

The number of specimens in this experiment as many as 12 pieces. 3 pieces without retrofiting wiremesh reinforcement, while nine other pieces by wiremesh reinforcement, with variations within connector 15 cm, 25 cm and 35 cm of each of 3 pieces. More detail can be seen in Figure 4.

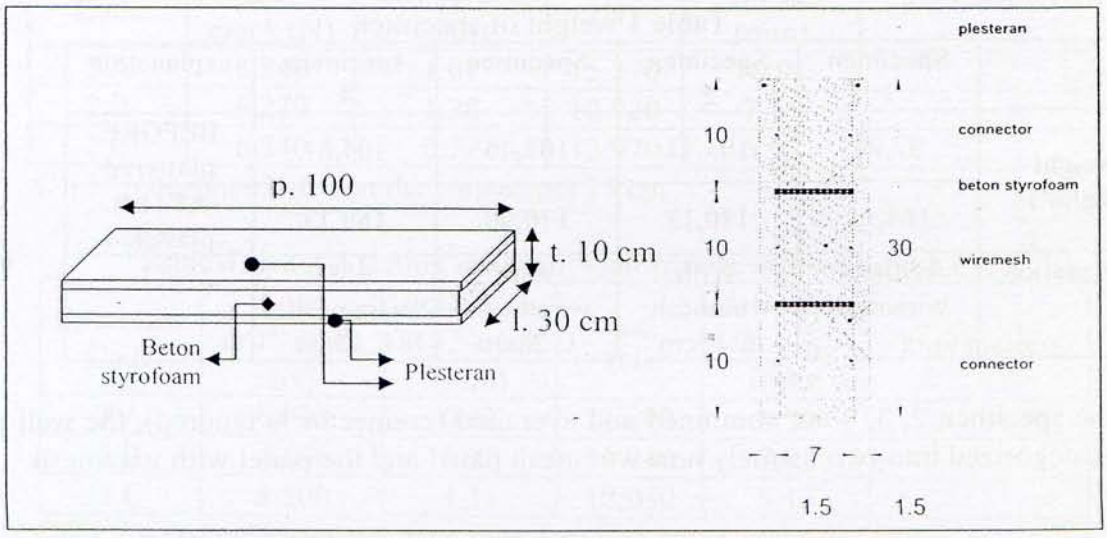


Figure 4 The shape and size of the specimen styrofoam concrete panel

Flexural testing steps consisted of several stages. first, the panel is measured to determine the

weight and dimensions of the panel before and after the plaster. Record the results. to be more easily observed at the time of testing, the panel was given the paint and help lines that describe the location and position of reinforcement wiremseh wire connector on each panel. testing tools are organized and prepared before laying the specimens. After that, place the panel on the pedestal and be ready for loading. Give loading with constant velocity. Record the peak load or the crack first when it happened. Stop charging if the panel is broken or has declined approximately 20% of peak load.

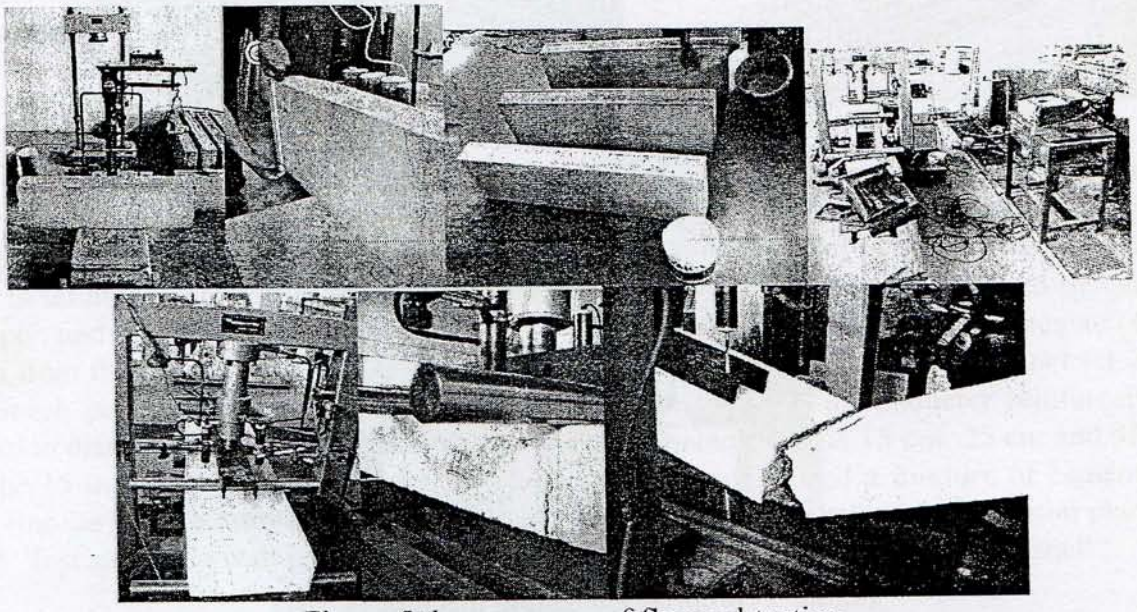


Figure 5 the sequence of flexural testing

3. RESULT AND DISCUSSION

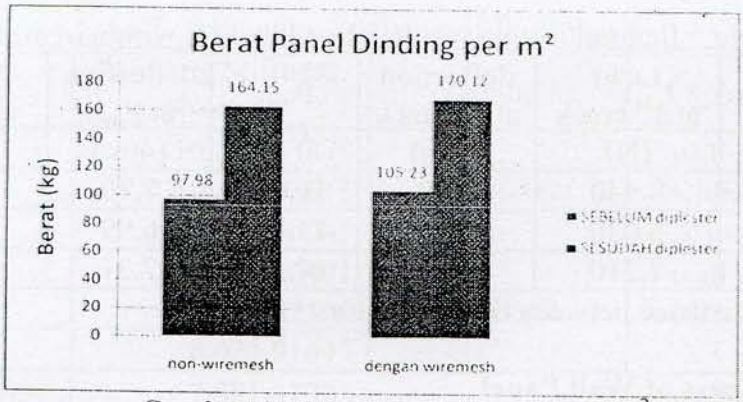
3.1 Weight of Wall Panel

Weight of the wall panel is obtained by comparing the weight and volume and area of the panel, as shown in Table 1 and Figure 6.

Table 1 weight of specimen

	Specimen 1	Specimen 2	Specimen 3	specimen 4	explanation
weight (kg/m^2)	97,98	103,43	107,46	104,81	BEFORE plastered
	164,15	170,12	170,90	169,33	AFTER plastered
explanation	Without wiremesh	With wiremesh, C.15cm	With wiremesh, C.25cm	With wiremesh, C.35cm	

If the the specimen 2, 3, 4 are combined and averaged (connector is ignored), the wall panels can be categorized into two, namely non-wiremesh panel and the panel with wiremesh.



Gambar 6 weight of wall panel (kg/m^2)

3.2. Flexural Testing Results

The results of flexural testing of each panel are as follows:

Table 2 flexural testing results of wall panels without the wiremesh

Specimen Code	Load at 1st crack (N)	deflection at 1st crack (mm)	P_{max} (N)	deflection at P_{max} (mm)	explanation
1.A	9.000	1,18	9.000	1,18	Suddenly broken
1.B	7.560	0,68	7.560	0,68	Suddenly broken
1.C	7.420	0,89	7.420	1,18	Suddenly broken

Table 3 flexural testing results of wall panels with wiremesh C-15*)

Specimen Code	Load at 1st crack (N)	deflection at 1st crack (mm)	P_{max} (N)	deflection at P_{max} (mm)	explanation
2.A	8.840	1,07	15.270	10,91	
2.B	6.270	1,28	10.920	7,36	
2.C	6.340	0,77	13.970	6,92	

C-15*) = distance between the connectors 15 cm

Table 4 flexural testing results of wall panels with wiremesh C-25**)

Specimen Code	Load at 1st crack (N)	deflection at 1st crack (mm)	P_{max} (N)	deflection at P_{max} (mm)	explanation
3.A	6.000	0,63	11.090	6,59	
3.B	4.430	0.72	11.810	7,92	
3.C	8.500	1.11	12.050	5,17	

C-25**) = distance between the connectors : 25 cm

Table 5 flexural testing results of wall panels with wiremesh C-35***)

Specimen Code	Load at 1st crack (N)	deflection at 1st crack (mm)	P_{max} (N)	deflection at P_{max} (mm)	explanation
4.A	8.440	0.80	11.630	7.70	
4.B	6.020	0.87	13.700	6.99	
4.C	7.210	0,92	14.430	7.31	

C-35***) = distance between the connectors : 35 cm

3.3. Bending Stiffness of Wall Panel

Bending stiffness is the ratio between the load with the deflection/deflection that occurs. This value is obtained by using the secant method to graph panel bending test until the time of the break /first crack.

Stiffness according to Timoshenko (1996) defined as the force required to produce a deflection of a single unit, such as the following equation:

$$k = \frac{P_{cr}}{\delta_{cr}} \quad \text{..... (1)}$$

Explanation : k = Bending Stiffness (N/mm)
Pcr = Load at 1st crack (N)
δcr = Deflection at 1st crack (mm)

Formula in Equation (1) can also be defined as secant method of stiffness formula (Figure 6). With this method the stiffness of the structure can be calculated based on the condition of crack initiation or at maximum loading.

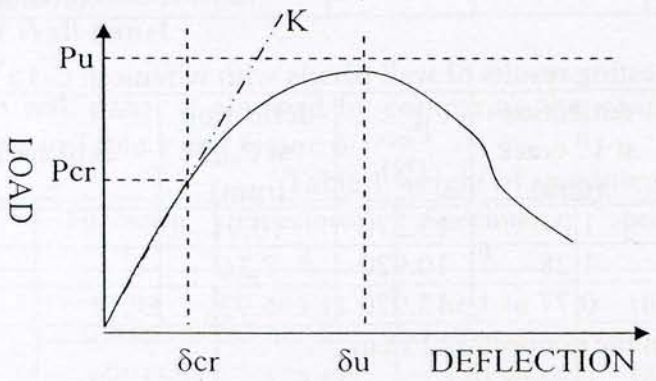


Figure 6 secant method of stiffness formula

The value of the bending stiffness of each the specimen panel in Table 6.

Table 6 Bending Stiffness of Wall Panel

Specimen Code	Bending Stiffness (N/mm)	Average	Explanation
1.A	10.127,83879	9.476,06	wall panels without the wiremesh
1.B	10.372,93615		
1.C	7.927,40045		
2.A	7.943,06491	7.283,67	wall panels with wiremesh C-15
2.B	5.884,02120		
2.C	8.023,91647		
3.A	7.881,37083	7.209,42	wall panels with wiremesh C-25
3.B	6.169,95308		
3.C	7.576,93157		
4.A	8.550,02119	6.936,23	wall panels with wiremesh C-35
4.B	7.130,87483		
4.C	5.127,79509		

based on result above, it can be concluded that non-wiremesh wall panels tend to be more rigid than the wall panel with wiremesh reinforcement. The closer distance of connector, may result in a higher bending stiffness.

3.4. Flexural strength of Panel

Value of the maximum bending stress styrofoam concrete wall panel (f_{maks}) test results obtained with the approach in accordance with Third Point Loading procedure based on SNI 03-4431-1997 which was adapted from ASTM C78-94.

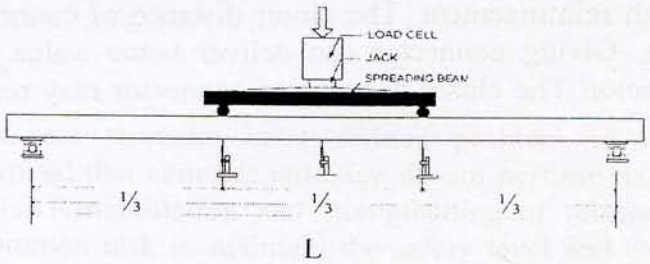


Figure 7 Illustration of flexural strength testing of the wall panel

$$f_{maks} = \frac{M_{maks} \cdot y}{I} \quad \text{..... (2)}$$

$$Mmaks = 1/8.q.t.L^2 + 1/6.P.L \quad \text{..... (3)}$$

explanation:

f_{maks} = Maximum Flexural Strength (MPa)
M_{maks} = Maximum moment (KNm)
L = length of panel (m)
q = weight per volume of panel (KN/m^3)
t = thick of panel (m)

P = load (KN)
y = distance of the outer portion from the neutral line (m)
I = cross-sectional moment of inertia (m^4)

The results of calculation of the value of panel flexural strength can be seen in Table 7.

Table 7 Flexural strength of Panel

Specimen Code	Max. Flexural Strength of Panel (MPa)	Average	Explanation
1.A	4,23	3,77	wall panels without the wiremesh
1.B	3,58		
1.C	3,51		
2.A	6,64	5,84	wall panels with wiremesh C-15
2.B	4,78		
2.C	6,08		
3.A	4,86	5,10	wall panels with wiremesh C-25
3.B	5,17		
3.C	5,27		
4.A	5,09	5,78	wall panels with wiremesh C-35
4.B	5,97		
4.C	6,28		

4. CONCLUSION

Wall panels of Styrofoam materials included in the category of lightweight concrete, because it has a weight of below 1800 kg/m3. non-wiremesh wall panels tend to be more rigid than the wall panel with wiremesh reinforcement. The closer distance of connector, may result in a higher bending stiffness. Giving connector can deliver better value of flexural strength, compared with no connector. The closer distance of connector may result a higher flexural strength.

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The International Conference on Sustainable Technology Development is designed to provide a platform for exchange of ideas, information and experiences among academics, researchers, consultants, engineers, manufacturers and postgraduate scholars in engineering; to promote cooperation and networking amongst researchers and professionals.

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