Int'l Conference Proceedings

5th International Conference on Research in Chemical, Agricultural and Biological Sciences (RCABS-2017)

International Conference on Studies in Architecture, Civil, Construction and Environmental Engineering (SACCEE-2017)

International Conference on "Advances in Engineering and Technology" (BICAET-17)

Jan. 10-11, 2017 Bali (Indonesia)

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Prof. Dr. Chairil Anwar

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PREFACE

Dear Distinguished Delegates, Colleagues and Guests,

The URUAE, EAP Organizing Committee warmly welcomes our distinguished delegates and guests at Universal Researchers (UAE), BICAET-17, Eminent Association of Pioneers in Research, RCABS-2017, and SACCEE-2017. Int'l Conferences scheduled on *Jan. 10-11, 2017 Bali (Indonesia).* The main themes and tracks are Chemical, Agricultural and Biological Sciences, Architecture, Civil, Construction and Environmental Engineering, Advances in Engineering and Technology.

These conferences are managed and sponsored by Universal Researchers (UAE), Eminent Association of Pioneers and assisted by University of Johannesburg and University of Quebec. URUAE, and EAP are striving hard to compile the research efforts of scientists, researchers and academicians across the broad spectrum of Science, Engineering and Technology. These conferences are aimed at discussing the wide range of problems encountered in present and future high technologies among the research fraternity.

The conferences are organized to bring together the members of our international community at a common platform, so that, the researchers from around the world can present their leading-edge work. This will help in expansion of our community's knowledge and provide an insight into the significant challenges currently being addressed in that research. The conference Program Committee is itself quite diverse and truly international, with membership from the America, Australia, Europe, Asia and Africa.

The conferences has solicited and gathered technical research submissions related to all aspects of major conference themes and tracks. This proceeding records the fully refereed papers presented at the conference.

All the submitted papers in the proceeding have been peer reviewed by the reviewers drawn from the scientific committee, external reviewers and editorial board depending on the subject matter of the paper. Reviewing and initial selection were undertaken electronically. After the rigorous peer-review process, the submitted papers were selected on the basis of originality, significance, and clarity for the purpose of the conference. The main goal of these events is to provide international scientific forums for exchange of new ideas in a number of fields that interact in-depth through discussions with their peers from around the world.

The program has been structured to favor interactions among attendees coming from many diverse horizons, scientifically, geographically, from academia and from industry. We would like to thank the program chairs, organization staff, and the members of the program committee for their work. We like to thank and show gratitude to Editors from URUAE, and EAP. We are grateful to all those who have contributed to the success of URUAE, and EAP Bali (Indonesia) Jan. 10-11, 2017 Conferences. We hope that all participants and other interested readers benefit scientifically from the proceedings and also find it stimulating in the Process in their quest of achieving greater heights. Finally, we would like to wish you success in your technical presentations and social networking.

We hope you have a unique, rewarding and enjoyable week at URUAE, and EAP Conferences at vibrant Bali (Indonesia).

With our warmest regards,

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Bali (Indonesia)

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The Evaluation of Environmentally Friendly Waste to Reinforced Concrete Beams

Tan Lie Ing, Ronald Simatupang, and Deni Setiawan

***Abstract*—**Concrete as one of the most attractive construction material because it has many advantages over other materials. Constituents of environmentally friendly concrete is required at this time to be created. One of the environmentally friendly waste materials to be used as a substitute PS Ball. PS Ball has compressive strength, hardness, anti-weathering than sand. The purpose of this research is to evaluate the effect of the waste material of reinforced concrete and to analyze structural elements after being loaded by monotonic and cyclic loading. Testing is conducted with experimental methods. The results of evaluation is reinforced concrete using waste materials can withstand greater loads than reinforced concrete beams by 13.9% during monotonic loading. The cyclic loading, the cumulative energy dissipation of reinforced concrete using waste material has better performance than the reinforced concrete without waste material and hysteresis curves of reinforced concrete using waste material is more stable and no pinching.

***Index Terms*—**cyclic, performance, reinforced concrete beams, waste.

I. Introduction

Construction building material which is frequently used is concrete. Concrete is desirable because it has many advantages compared with other materials, among other things: relatively inexpensive price, good strength, constituent raw materials readily available, durability, resistance to fire, and so forth. Concrete technology innovation is always required in order to answer the challenge which will be a requirement. The resulting concrete is expected to have high quality which includes strength and durability without neglecting its economic value. Moreover, with increasing climate change we need an innovation in the world of construction in order to create a concrete constituent material friendly to the environment. One way to use the waste production of steel is called the PS Ball.

The improved quality of concrete can be done by adding or replacing the materials used. Substitutes have been done in previous studies. In this research, the replacement material used is PS Ball and is expected to replace the concrete sand with PS Ball which can enhance the compressive strength of concrete.

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PS Ball is very superior to the sand in terms of compressive strength, hardness, and anti-weathering. PS Ball is suitable for various applications due to their physical and chemical properties. The most important is the fact that the PS Ball is harmless and environmentally friendly technology. The purpose of this research is to evaluate the effect of the waste material of reinforced concrete and to analyze structural elements after being loaded by monotonic and cyclic loading.

II. Literature Review

A. PS Ball

EAF slag is a by-product with a large volume formed in the steel-making process (15% to 20% of the capacity of liquid steel), and still contains the remnants of metal. This slag handling is previously difficult and inefficient. Atomizing technology slag (slag atomizing Technology: SAT) is a new system to form a molten slag into small droplets (atomize) of Electric Arc Furnace (EAF) with high efficiency. Material results of the SAT spherical diameter and size are different, and so-called PS (Precious Slag).

SAT operates the first plant in 1997 in Korea, since the total installed capacity has increased to 1.12 million tons. Capacity is under construction and projected to be realized in 2009 in South Korea, South Africa, Malaysia, Thailand, Taiwan, Indonesia, Iran, Vietnam, and the United States totaled 3.4 million tons. On December 1, 2008 SAT PT Full Steel Plant in Harsco (in the area of the factory of PT Krakatau Steel) started operating, with the capacity of 5.000 tons per month.

SAT is the process of changing the liquid slag (1500°C-1550°C) into small balls with a diameter ranging from 0.1 mm to 4.5mm. The process in the form of high-speed wind system with catalyst and water to the flow of liquid slag is poured through the tundish toward the slag pitt. With the help of water, high-speed air flow generates heat exchange with the fast-changing stream of slag into balls (PS Ball) with a shiny surface.

PS Ball is an environmentally friendly product processed B3 waste material that can be used as a replacement for quartz sand blasting. In Fig. 1 we can see the process of production of PS Ball.

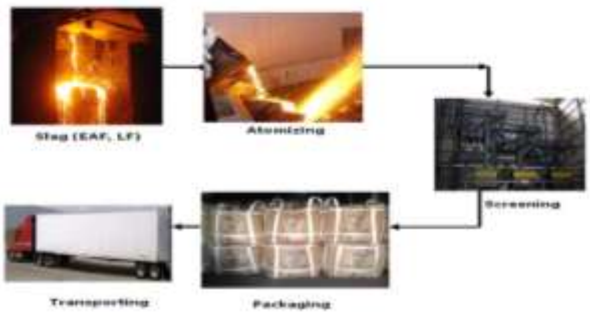

Fig. 1. Production Process PS Ball

In the SAT process, molten slag is cooled quickly by air and water high speed. Various unstable elements form CaO-Fe2O3, SiO2-Fe2O3 and Mg-Fe2O3. There is no free CaO in the product and the surface will be shiny with spinel structure. Spinel structure is a combination of CaO-Fe2O3, CaO-SiO2. In Fig. 2 can be seen in the form of granules of PS Ball.

Fig. 2. Characteristics of PS Ball

Spinel structure is the main characteristic of this material, physical structure and clams stable eliminate pollution reasons. Characteristics of PS Ball material compared to other materials there can be seen in Table I.

TABLE I: CHARACTERISTICS MATERIAL PS BALL

Classification	PS Ball	Sand	Garnet	Glass Bead	Steel Ball
Actual Specific Gravity	3.45	2.62	4.2	2.6	7.2
Mohs Hardness	7.5	5.5	7.5	5	8.5
Rockwell Hardness (HRC)	43	30	40	28	50
Brightness (quality grade)	Very good	Normal	Good	Normal	Very good
Reusability	1-3 times	0ne time	1-3 times	One time	5-7 times

PS Ball is very superior to the sand in terms of compressive strength, hardness, and anti-weathering. As new materials, PS Ball has the advantage of physical properties and chemistry that provides the ability for a variety of wide applications, such as coating precarious metal, manholes, sandpaper, road compaction, material ballast, silencers, protective radiation, a mixture of cement, floorings, soil compactor, piling, water treatment and waste water, filter materials, materials that are not slippery floors, brick, concrete, and prefabricated materials.

Some other advantages in the use of PS Ball:

1. PS Ball is the kind of product that is environmentally friendly, safe, and free from toxic or crystalline silica;
2. Low dust;
3. High productivity. PS Ball is quickly cut into the surface because of the character of the raw materials, the speed, force (7.5Mohs) and forms that have an impact on the surface;
4. Low consumption of
   SSPC SP-6/Sa 2 : 18 kg/m^2
   SSPC SP-10/Sa 2,5 : 32 kg/m^2
   SSPC SP-5/Sa 3 : 52 kg/m^2
5. Recycling. PS Ball can be used 2 to 3 times

The usefulness of waste steel PS Ball can be used among others as abrasive blasting material, weight material, casting sand, water treatment, roofing granules, material non-slip, reinforcement materials, poly-concrete material, sand-pile material, road pavement material, and permeable reactive material.

B. Concrete

Concrete is a construction material that is commonly used for buildings, bridges, roads, and others. It is a homogeneous entity and obtained by mixing fine aggregate (sand), coarse aggregate (gravel), water, and cement. Otherwise, it may be given additional materials chemically or physically at a certain ratio to become homogeneous. The properties that must be possessed by concrete are:

1. Durability;
2. Compressive strength;
3. Tensile strength;
4. Modulus of elasticity;
5. Creep;
6. Shrinkage;
7. Workability.

When the concrete structure works resist loads of assuming, concrete beams will experience stresses on the body. Concrete without cracks usually occur in a small load when the tensile stress voltage is lower than the collapse modulus (flexural tensile stress at the time of the concrete begins to crack). The entire anchoring transverse beam resist bending, with the press on one side and the other side. When the concrete begins to crack caused by the weight increasing beyond the modulus of the beam collapse, cracks begin to occur at the bottom of the beam. The moment when the cracks start to form is when the tensile stress at the bottom of the beam is equal to the modulus of the collapse of the so-called cracking moment, M_{cr}. If the load is continuously increased, cracks began to spread and approach the neutral axis. Cracks occur in places along the beam where the actual moment is greater than the cracking moment.

In addition to bending crack, crack sliding generally occurs. This is caused by the distribution of loading on which each beam is not the same. Shear crack is a sign that the tensile crack begins to occur and a continuation of bending cracks. Shear cracks are not allowed in flexural testing and construction of buildings, as a result of shear cracks of a building would immediately collapse in an instant. Bending type of failure can be seen in Fig. 3.

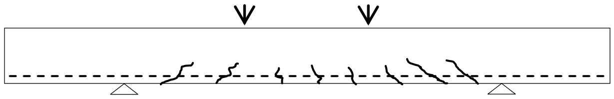

Fig. 3. Bending Failure

There are basically three types of cracks in structure such as in Fig. 4, that is:

1. Flexural crack, cracks that occur in areas that have a large bending moment. Direction nearly perpendicular cracked beam axis;
2. Flexural shear crack, cracking that occurs at the beam flexural cracks that previously occurred. Bending shear cracks are oblique crack propagation of cracks that had happened before;
3. Shear crack, cracks that occur in areas where the maximum shear forces to work and normal stresses are very small.

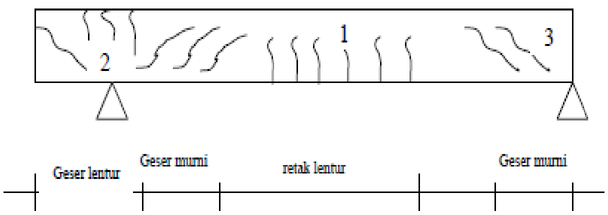

Fig. 4. Type of Crack on the Beam

III. Research Method

In this research, the data obtained by the experimental method. Testing was conducted on a cantilever beam. Loading applied to the specimen carried out into two phases, that is:

1. Monotonic loading is the imposition of a one-way on the structure of zero load to achieve structures that cause destruction. Imposition settings that are important in this test are the loading speed settings. This research was conducted at the speed of loading of 0.03mm/second, which is determined similar for each type of loading applied to the specimen;

2. The cyclic loading changes the direction of loading on structures caused by earthquakes. Cyclic loading is considered complete when the peak load that can be accepted by the structure at a given cycle has decreased. Cyclic loading pattern applied to the specimen is divided into 10 groups. Force is applied to one loading direction of the deflection zero to reach a certain deflection, then changed to the opposite direction so the beam deflection reaches a certain value. Limit deflection in a group of loading refers to the melting deflection and multiplication. The entire loading is done with the speed of 0.03mm/second. The cyclic loading pattern applied can be seen in Fig. 5.

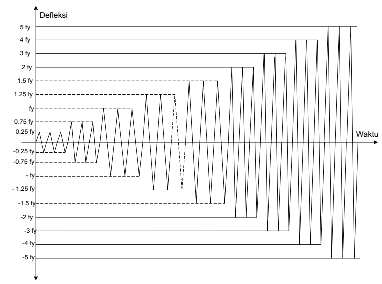

Fig. 5. Cyclic Loading Pattern

IV. Data Analysis And Discussion

A. Analysis of Reinforced Concrete Beam Testing Using PS Ball and without PS Ball with Monotonic Loading

The yield load of reinforced concrete beams using PS Ball, when the beam is loaded by monotonic load results 50 kN and the yield displacement is 20 mm.

The ultimate condition of reinforced concrete beams using PS Ball can withstand a load of 79.01 kN and collapse when the displacement reaches 135 mm. Dactility displacement is determined but the ratio of ultimate displacement and yield displacement, obtaines ductility reinforcement of 6.5.

The test result of reinforced concrete beams without PS Ball obtaines yielding load with monotonic load is 48.5 kN with a yielding displacement is 14.5 mm. Reinforced concrete beams without PS Ball can withstand loads of up to 90 kN. Reinforced concrete beams without PS Ball collapse when displacement reaches 66.4 mm. Ductility displacement of reinforced concrete beams without PS Ball is obtained from the test results using the monotonic load is at 4.5. This shows that the reinforced concrete beams using PS Ball is more ductile than the reinforced concrete beams without PS Ball. The comparison of the test results of reinforced concrete beams using PS Ball and reinforced concrete beams without PS Ball on monotonic behavior by a given load can be seen in Table II.

TABLE II: Comparison Of Reinforced Concrete Beam Using Ps Ball And Without Ps Ball With Monotonic Load

Condition	Curvature		Moment (kNm)		Load (kN)	
	Beam with PS Ball	Beam without PS Ball	Beam with PS Ball	Beam without PS Ball	Beam with PS Ball	Beam without PS Ball
Crack	8,36E-06	1,45E-06	23,19	14,64	15,46	9,76
Yield	4,2E-05	2,2E-06	75	72,75	50	48,5
Ultimate	8,72E-05	4,17E-05	118,1	134,4	79,01	90

B. Analysis of Reinforced Concrete Beam Testing Using PS Ball and without PS Ball with Cyclic Loading

Cyclic testing on reinforced concrete beams using PS Ball is conducted to the condition in which the displacement of the beam reach 5Δy. The amount of energy dissipation of reinforced concrete beams using PS Ball during cyclic loading can be seen in Table III.

TABEL III: DISSIPATION ENERGY OF REINFORCED CONCRETE BEAMS WITH PS BALL

Cycle	Dissipation Energy (kNmm)		Total Dissipation Energy (kNmm)	Mean Dissipation Energy (kNmm)	Cumulative Dissipation Energy (kNmm)
	Stress	Compression			
0.25 Δy	17.99	13.29	31.28	32.73	32.73
	19.38	14.81	34.19		
0.5 Δy	42.95	59.28	102.23	100.42	133.15
	40.40	58.20	98.60		
0.75 Δy	166.91	280.02	446.93	374.95	508.10
	109.71	193.27	302.98		
Δy	242.38	522.12	764.49	733.76	1241.86
	212.28	490.74	703.02		
1.25 Δy	402.03	899.31	1301.34	1404.32	2646.18
	431.47	1075.82	1507.29		
1.5 Δy	681.82	1624.38	2306.21	2389.01	5035.19
	710.30	1761.51	2471.81		
2 Δy	1203.44	2857.47	4060.90	4212.72	9247.91
	1275.60	3088.94	4364.54		
3 Δy	2594.03	5867.37	8461.40	7949.39	17197.30
	2499.79	4937.60	7437.39		
4 Δy	3763.56	8908.68	12672.24	12672.24	29869.54

Total cumulative energy dissipation reinforced concrete beams using PS Ball is at 29869.54 kNmm. The pattern collapse that occurrs in reinforced concrete beams using PS Ball is the one due to bending. It can be seen from the pattern of cracks that occur on the specimen that is cracks occur in the form of vertical cracks. The maximum compressive load to bear tensile reinforcement in reinforced concrete beam using PS Ball amounts to 112.20 kN. In the hysteresis curve occurs pinching on reinforced concrete beams without PS Ball.

The greater the decrease in energy dissipation along with the increasing load can be seen in Table IV. The difference between the cumulative energy dissipation reinforced concrete beams using PS Ball and reinforced concrete beams without PS Ball is 50%. Fig. 6 shows a comparison of hysteresis curve of reinforced concrete beams using PS Ball and reinforced concrete beams without PS Ball.

The peak load of reinforced concrete beams without PS Ball is higher than the reinforced concrete beams using PS Ball. In addition hysteresis curve of reinforced concrete beams using PS Ball is more stable than the reinforced concrete beams without PS Ball. It can be seen from the hysteresis curve where the greater load is applied to the beam, the greater hysteresis curve is formed. In the hysteresis curve of reinforced concrete beams using PS Ball pinching does not occur as happening in reinforced concrete beams without PS Ball.

IV. CONCLUSION

Reinforced concrete beams without PS Ball is capable of withstanding a load of 90 kN while reinforced concrete beams using PS Ball is capable of withstanding a load of 79 kN. So the increasing load as much of 13.9% occurs on reinforced concrete beam using PS Ball. Displacement reinforced concrete beams without PS Ball is of 20 mm while the displacement of reinforced concrete beams using PS Ball is of 14.5 mm. This indicates that the reinforced concrete beams using PS Ball can withstand monotonic load better than the reinforced concrete beams without PS Ball.

Based on cyclic testing, the cumulative energy dissipation that reinforced concrete beams using PS Ball receiving cumulative energy dissipation is better than reinforced concrete beams without PS Ball, and the reinforced concrete beams using PS Ball have better performance than reinforced concrete beam without PS Ball.

Based on cyclic testing, hysteresis curve shows that the reinforced concrete beam using PS Ball is more stable than reinforced concrete beam without PS Ball. Reinforced concrete beam using PS Ball does not occur pinching while reinforced concrete beam without PS Ball occurs.

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TABEL IV: DISSIPATION ENERGY OF REINFORCED CONCRETE BEAMS WITHOUT PS BALL

Cycle	Dissipation Energy (kNmm)		Total Dissipation Energy (kNmm)	Mean Dissipation Energy (kNmm)	Cumulative Dissipation Energy (kNmm)
	Stress	Compression			
0.25 Δy	9.12	19.31	28.42	26.66	26.66
	11.75	13.14	24.89		
0.5 Δy	27.88	49.77	77.65	75.78	102.44
	25.09	48.82	73.91		
0.75 Δy	51.98	100.59	152.57	140.22	242.66
	46.22	81.65	127.87		
Δy	103.12	206.76	309.89	307.23	549.89
	100.18	204.39	304.57		
1.25 Δy	155.40	319.58	474.98	467.43	1017.32
	149.13	310.75	459.88		
1.5 Δy	208.37	472.74	681.11	677.17	1694.49
	206.90	466.34	673.23		
2 Δy	378.29	849.42	1227.71	1224.60	2919.09
	372.64	848.85	1221.49		
3 Δy	958.96	2231.80	3190.76	2814.87	5733.96
	767.11	1671.87	2438.98		
4 Δy	1374.79	3329.47	4704.25	4161.73	9895.69
	1141.40	2477.80	3619.21		
5 Δy	1730.28	4315.03	6045.31	5210.49	15106.18
	1265.22	3110.46	4375.68		

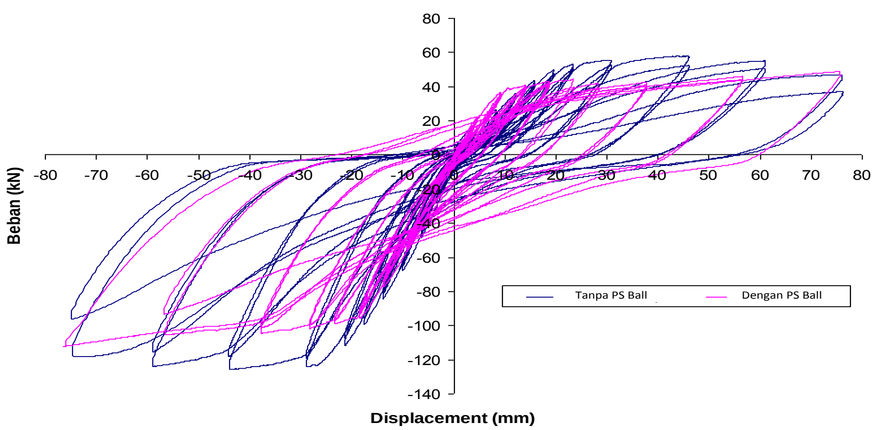

Fig. 6. Comparison of hysteresis curve of Reinforced Concrete Beams Using PS Ball and Reinforced Concrete Beams without PS Ball