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The Use of Lightweight Brick and Bamboo on Lightweight Reinforced Concrete Panel Subject To Horizontal In-Plane Loading

Sri Murni Dewi, Endah Tri Puspitasari, Miftakhul Jannah, Chairita

Abstract: The lightweight panel is widely use in building infilled wall to reduce the building mass in lieu of brick walls. The present innovation works use bamboo and aerated concrete blocks into precast concrete panel. The average weight of the panel was 1650 kg/m3 compare to ordinary reinforced concrete 2200 kg/m3. Two type of panel dimension were used 40 cm x 80 cm x 3 cm and 60 cm x 120 cm x 4 cm. Bamboo reinforcement act as a structural framework of the panel and aerated concrete block (AAC block) functioning as infilled wall or cladding. Panels were loaded at the in- plane panels at two position, namely at the peak and at the middle panel height. When the load position was at the peak the average failure loads were120 N for small and large panel, the failure occurred at compression at top diagonal frame. when the load position was at mid panel, the average failure loads were140N for small panel and 260N for large panel, the failure occurred as shear cracks on the panel.

The failure load of panel without aerated concrete blocks were130N for small panel and 215N for large panel.

key words: bamboo reinforced concrete, aerated concrete block, lightweight panel.

I. INTRODUCTION

Innovation in the form of structure and material usage have the potential to prevent over dependence on non-renewable materials like, sand, cement, and gravel that are used for construction. This will definitely help to arrest the accompanying environmental degradation that accompanies extraction of non-renewable materials.

The conventional concrete is strong but high in self weight. This factor effects construction time and the worker which will lengthen the construction period.

The use of lightweight precast panel on wall and room divider is a mayor requirement for building industry. Precast walls are often used as a room divider in rental offices. The wall does not carry the vertical loads, but their own weight influences the mass of the building.

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* Correspondence Author

Sri Murni Dewi*, Civil Engineering Department, Brawijaya University, Malang, Indonesia. Email: srimurnid@ub.ac.id

Endah Tri Puspitasari, Civil Engineering Department, Brawijaya University, Malang, Indonesia.

Miftachul Jannah, Civil Enginering department, Brawijaya University, Malang, Indonesia. Email:

Chairita, Architectural Engineering Department, Tama Jagakarsa University, Jakarta, Indonesia

Some walls designed to resist wind or earthquake loads. As room divider for the wall, the precast system is suitable choice. Although it more expensive than masonry wall, it can reduce the time construction required and amount of site lab works.

Bamboo is now being used as a substitute for steel reinforcement. It has sustainable and renewable natural resources. The weight of bamboo is less than conventional steel reinforcement. The use of bamboo reinforcement has been developed by many researchers. [1], [2], [3], [4], [5]. [6], and [7].

The combination of normal concrete with lightweight material like an autoclaved aerated concrete block developed by Dewi [7] and the combination with expanded polystyrene or better known as Styrofoam developed by Wibowo [8]. In those combination normal concrete act as structural part and lightweight material act as a nonstructural infilled.

The in plane shear resistance of wall usually tested by applying loads at the top wall while the wall is fixed in the strong floor [9]. The load can either monotonically and cyclically.

These paper present the experimental works on laboratory of precast light weight panel composite. The wall panel made from bamboo frame, the aerated concrete blocks, wire mesh and mortar.

II. MATERIALS AND METHODS

A. Panel Composition

Bamboo frame were made from bamboo bars 8 x 6 mm manufactured by splitting Petung bamboo. The bamboo bars were coating and varnished to make it more waterproof and sand coated to make it more rough.

The aerated concrete blocks replace into the space of the frame as shown in Fig-1. Wire mesh 20 x 20 mm covered both side of panel surface before casted. The panel casted with mortar and put some coarse aggregate 8-10 mm on bar-frame area. The average concrete compressive strength and bamboo tensile strength were 18 MPa and 140 MPa respectively.

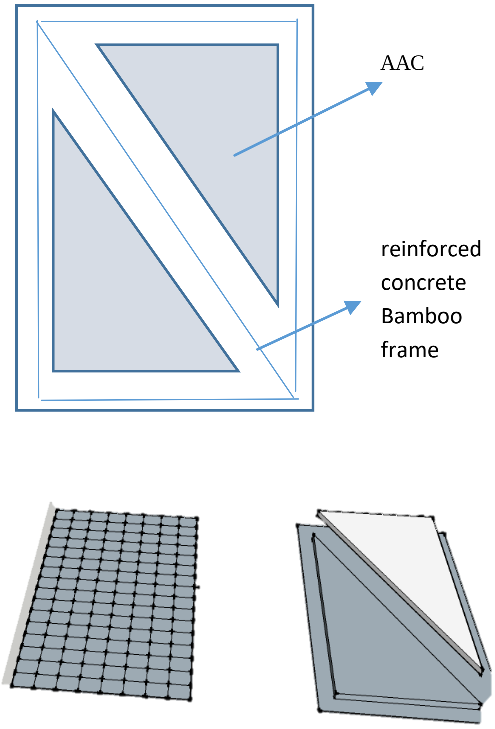


Figure-1 Precast Wall Component

B. Panel dimension and Weight

Two type of panel dimension were used 40 cm x 80 cm x 3 cm and 60 cm x 120 cm x 4 cm. Three sample specimen for each dimension with AAC blocks and one sample control specimen for each dimension without AAC blocks.

The panel weight for 40 cm x 80 cm x 3 cm dimension are shown in Table-1, and panel weight for 60 cm x 120 cm x 4 cm are shown in Table-2

Table-1:40cm x 80 cm x 3cm panel.

panel	Weight kg
A1	18,30
A2	18.20
A3	18,25
NC	22,65
B1	18.50
B2	18.40
B3	18,40
NC	22,65

Table-2: 60 cm x 120 cm x 4 cm panel.

panel	Weight kg
C1	45.30
C2	45.20
C3	44,90
NC	62,30
D1	45,30
D2	45.70
D3	45.10
NC	62,30

C. Laboratory Works

The wall specimen tested with in-plane loads at the top of the wall and at middle height of the wall. Figure 2 and Figure 3 shown the schematic diagram of the test set up.

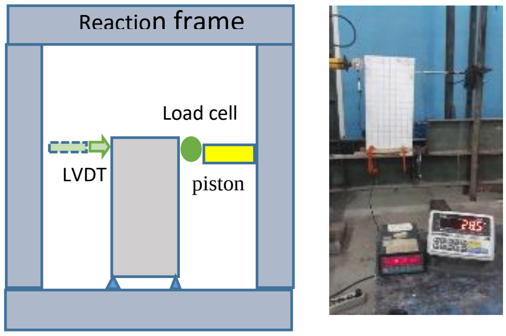


Figure 2: Test Setup for top position loads

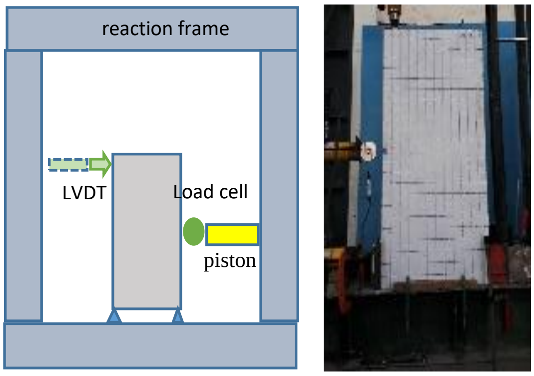


Figure 3: Test set up for middle position loads

Loading was given gradually in stages up to failure and the experimental deflection and cracks propagation were recorded until the ends.

III. RESULTS AND DISCUSTION

A Failure Loads

The failure loads for 40 cm x 80 cm x 3 cm panels at top position loads and middle position loads are shown in Table-3

Table-3: Failure Loads of Small Panels

panel	Loads N	position
A1	70	Top
A2	114	Top
A3	126	Top
NC	139	Top
B1	80	Middle
B2	119	Middle
B3	120	Middle
NC	200	Middle

The failure loads for 60 cm x 120 cm x 4 cm panels at top position loads and middle position loads are shown in Table-4

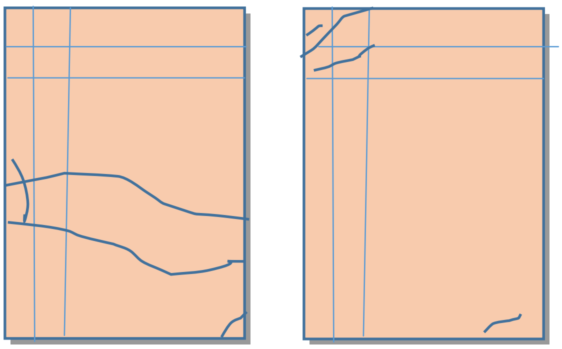
Table 4: Failure Loads of Large Panels

panel	loads	position
C1	80	Top
C2	119	Top
C3	90	Top
NC	219	Top
D1	183	Middle
D2	169	Middle
D3	191	Middle
NC	218	Middle

For loads on top position, there were no different loads between small panel and large panel, but when loads acted in the middle position there were different loads between them.

B. Cracks Pattern

Cracking in concrete is important to observe therefore the cause of failure can be known.



(a) (b)

Figure-4: Crack Pattern (a) middle position, (b) top position

When load acted in top position the cracks indicate the compression failure in bamboo frame as shown in Fig.4(b). Then there was no different load value between small and large panel. When load acted in middle position the cracks indicate the combination of shear failure and compression failure as shown in Fig.4(a). There was some different load value between small and large panel. The wire mesh covered the panel surface should reduce the mortar failure of the panel in loads contact.

IV. CONCLUTION

1. The use of AAC should reduce the panel weight 18%
2. The failure of panel when loads in top position were compression at corner panel
3. When load position at the middle of panel, the shear failure and compression at load contact occurred.
4. There was no significant difference between lightweight panel load and normal concrete panel load.
5. For the next research, it is recommended to increase mortar strength and design the panels joints.

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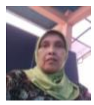
AUTHORS PROFILE



Sri Murni Dewi working as Professor in Civil Engineering at Brawijaya University Indonesia PhD in Structural Engineering from ITS Indonesa. Research works in bamboo construction and lightweight material

Endah Tri Puspitasari, Master Student in Structural Engineering at Brawijaya University Indonesia
.

Miftakhul Jannah. Master Student in Structural Engineering at Brawijaya University Indonesia

Chairita,,Master in Construction Management from Tama Jagakarsa University Indonesia. working as Lecture in Department of Architecture at Tama Jagakarsa University Indonesia.