# EMAIL TO THE EDITOR

A critical review of ***"Development and behaviour of light weight foamed concrete wall panel"*** by Mohd Arif Sulaiman, Siti Hawa Hamzah, Sabarudin Mohammad, Rokiah Othman and Alex Liew Chung Meng.

This article was published on ***IEM Journal, March 2009, Vol 70 No. 1 (pp. 14 – 20)***. Ir. Tu Yong Eng requested a thorough study on the article was carried out and the followings required for further clarification from the author:

**[1]** *Light weight foamed concrete* (LFC) is not even concrete, but rather mortar. Reference to concrete codes may not be suitable. Please refer to Section 5, BS 8110 – 2.

**[2]** For the experimental set-up, the description, figure 1 and figure 2 are different. Based on Figure 2, the effective height will be very much reduced. Furthermore, the effect of the supports shall be thoroughly studied to understand its effect.

**[3]** The loading arrangement may not be able to produce uniform loading condition. (*i.e.* steel bar welded to steel plate). Stress concentration may be induced.

**[4]** Actual density of LFC is not given. This may be crucial if the variance of the density is too high.

**[5]** Insufficient test cubes were prepared and hence variation of the strength can not be ascertained. Furthermore, the characteristic strength of the LFC cannot be ascertained as well.

**[6]** Results for T6 and T7 were not given. It should be a good comparison and an indication for the behaviour of the edge.

**[7]** Initial curvature is not measured. This is an important parameter since the comparison of the capacity was made to BS 8110 and ACI308 where the initial curvature has already taken into considerations. Furthermore, initial curvature will determine the direction of the horizontal deflection after loading.

**[8]** Initial eccentricity is also not measured.

**[9]** For the stress strain relationship, it is expected that uniform stress is used instead of actual stress at the location of the strain gauge. This estimation may not be accurate enough since the wall has high curvature after loading.

**[10]** W1400 and W1600 at Figure 7 looks mixed up. Please clarify.

**[11]** By comparing plots for S1W1400 and S2W1400 (as well as S1W1600 and S2W1600) in figure 7 also suggested that the location of the strain gauges may not be suitable. The results were inconsistence.

**[12]** It is strange to compare the modulus of LFC (with such a low strength) with conventional concrete of grade 30 (C30 concrete).

**[13]** Brittleness is not measured by modulus of elasticity. Hence, the last sentence of paragraph 3.3 is not justified.

**[14]** Failure debris does not necessarily shown that it was buckling failure because buckling normally shown the crushing at (or near to) the mid span. Confirmation of the mode of failure needed.

**[15]** Lateral displacement also shown that the LFC wall is weak for eccentricity loading.

**[16]** $f_{cu}$ in formula (2) (ACI 308) should be cylindrical strength, and not the cube strength. *Likewise* for formula (3) and (4).

**[17]** Formula (5) (equation 44 in BS 8110, part 1) is also not correct. It should be $2e_a$ instead of $3e_a$.

**[18]** To have meaningful comparisons with BS 8110 and ACI 308, proper eccentricity and curvature shall be simulated, otherwise the ultimate strength will be over estimated. Factor of safety was built into the formulae of BS 8110 and ACI 308. For a meaningful comparison, these factors shall be removed.

**[19]** Reference is made to Section 5.8.3, BS 8110 part 2 for light weight aggregate concrete, $e_a$ for equation 44 of BS 8110 part 1 shall be revised to $l_e/1700h$. (most probably $l_e^2/1700h$) (*Remark:* This is for comparison purposes only, since BS 8110 did not provide guidelines to LFC).

**[20]** Tabulation of Table 4 seems to be incorrect. Please confirm. For example, based on formula (2) and (3), ultimate strength predicted by ACI is actually higher than that of Orberlender and Overard but shown otherwise in Table 4.

**[21]** Since the failure is expected to be buckling, why Euler buckling load was not computed?

**[22]** First sentence of the *conclusion - What is* "lightweight forward concrets"?

**[23]** Is it significant to compare test cube strength between C1400 and C1600 based on single sample result?

**[24]** Two wall panel - . *What* is the effect of the variation of the strength of the material, initial curvature and eccentricity?

• ***Author's reply***

Your critical review on ***'Development and behaviour of light weight foamed concrete wall panel'*** is highly appreciated and we regret some of the mistakes occurred in this article as pointed out by you. Your comments become serious matter to us and we are highly concern. In actual fact, this particular article is the preliminary study for the lightweight foamed concrete wall panel because the use of the light weight foamed concrete is relatively new in Malaysia and there is no set of standard which provide us with clear guideline to follow or to refer to just as yet.

With that said, our response to your comment is as follow;

**[1]** The density of *light weight foamed concrete* (LFC) ranges between 300 kg/m$^3$ to 1800 kg/m$^3$. According to LCM Sdn.Bhd and BCRC, the densities for wall panel are recommended to be in the range of 1400 kg/m$^3$ to 1600 kg/m$^3$. Therefore this study was carried out to investigate the structural behavior of lightweight foamed concrete wall panel in term of ultimate load and mode of failure.

**[2]** Table 2 presents the average compressive strength for LFC cube test. A series of cubes were tested at age 7, 14, 28 and 60 days whereby 3 cube specimens were tested each day.

**[3]** The experiment was set-up at the Heavy Structures Laboratory, Faculty of Civil Engineering, UiTM Malaysia. Figure 1 and Figure 2 represent the experimental set-up and arrangement of LVDTs respectively. In this study, the arrangement of LVDT's and ESG's was adopted from Siti Hawa Hamzah at al. (*Wire Fabric Reinforced Concrete Wall Panel., World Housing Congress, Terengganu, Malaysia 1-5 July 2007*).

**[4]** The loading system was well designs and the loads were well distributed. The Figure A shows the cast iron trapezium shape was tight to the load cell. The steel bar was welded to steel plate to make sure that the wall panel tested under pure axially load (*eccentricity* = 0).

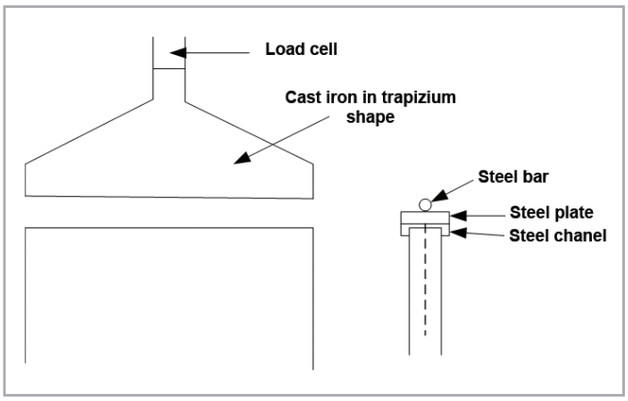


***Figure A***

**[5]** Table 4 shows the comparison between experimental and theoretical values of ultimate load for wall panel. We concur that a few mistakes occur in the Formula (2), (3) and (4) were due to our *'misinterpretation'* of the value of the fcu. Benayoune at al (Respond of pre-cast reinforced composite sandwhich panel to axial loading sciece direct) also defined $f_{cu}$ in the formula as a compressive strength of cube concrete not cylinder concrete.

**[6]** In Formula (5), it should be read as $2e_a$ instead of $3e_a$. By recalculating, the ultimate load should be 286.90 kN and 203.66 kN for wall panel W1600 and W 1400 respectively.

**[7]** The wall panel was failed by abrupt fracture but referring to the lateral displacement profile, the wall panel also failed by buckling.