# CHAPTER 5 CONCLUSIONS AND FUTURE WORKS

In this study, use of calcium carbide residue and pozzolanic materials mixtures as a new binder for concrete was evaluated. In addition, Portland cement (OPC) was used as an accelerator to improve property of concrete. Furthermore, durability of the concrete from new binder in term of water permeability property was also evaluated. Moreover, heat evolution of high-strength concrete was monitored. For concrete brick, compressive strength and water absorption were discussed. The conclusions and suggestions for further study are as follows:

## 5.1 Conclusions

Based on the experimental results, the following conclusions can be drawn:

5.1.1 Ground calcium carbide residue (CR) and pozzolanic materials such as ground pulverized coal combustion fly ash (FM), ground fluidized bed fly ash (FN), ground palm oil fuel ash (PA), and ground rice husk-bark ash (RA) could be used together as a new binder for casting concrete. The compressive strength of CR-pozzolans concretes ranged from 10.4 to 33.5 MPa at 28 days, and increased to be 14.2 to 56.1 MPa at 180 days even though the CR-pozzolans concretes contained no Portland cement.

5.1.2 CR-FN and CR-RA mixtures required superplasticizer higher than that of CR-PA mixture while CR-FM mixture required no superplasticizer to maintain the slump within the controlled range between 50-100 mm. The superplasticizer dosage in CR-pozzolan concrete is increased when the W/B ratio is decreased. The use of 10% OPC as an accelerator could reduce the amount of superplasticizer required in the CR-pozzoalns concrete mixture compared to the concrete without OPC.

5.1.3 Because the initial and final setting times of CR-pozzolans concretes were much longer than those of normal Portland cement concrete, CR-pozzolans concretes should be considered carefully for use in construction work. However, the use of Portland cement (OPC) 10% by weight of binder exhibited in accelerating the setting times of CR-pozzolans concretes.

5.1.4 The highest differential temperatures between CR-FM concretes and the ambient condition were found to be 11 and 15°C for CR-FM(0.25) and CR-FM(0.25)10 concretes, respectively. The highest temperature rise of CR-FM(0.25) and CR-FM(0.25)10 concretes were about 0.26 and 0.36 times that of the Portland cement concrete NC(0.25), respectively. In addition, the times to obtain the highest temperature rise of CR-FM(0.25) and CR-FM(0.25)10 concretes did not have much difference from the Portland cement concrete NC(0.25).

5.1.5 The mechanical properties of CR-pozzolans concrete (with or without OPC) were similar to the Portland cement concrete. The compressive strength increased with age, the modulus of elasticity increased with the increased compressive strength, and the splitting tensile strength increased with the increased compressive strength and was about 9 - 16% of the compressive strength at 28 days.

5.1.6 Use of OPC at 10% by weight to replace binder had a significantly affected improving compressive strength, splitting tensile strength, and elastic modulus of CR-pozzolans concrete. The compressive strength of CR-FM(0.25)10 concrete (W/B ratio of 0.25) was 42.3 MPa at 28 days, and increased to be 72.4 MPa at 180 days although the concrete had OPC of 55 $kg/m^3$.

5.1.7 The water permeability values of CR-pozzolans concretes without OPC varied from $0.65x10^{-12}$ to $81.92x10^{-12}$ m/s at 28 days depending on the type of pozzolan, compressive strength, and age of concrete. Use of OPC at 10% by weight of binder in CR-pozzolans concrete resulted in effectively increasing the impermeability as well as the compressive strength. At 90 days, the water permeability of CR-FM(0.45)10, CR-FN(0.45)10, CR-PA(0.45)10, and CR-RA(0.45)10 concretes were $0.30x10^{-12}$, $0.14x10^{-12}$, $0.42x10^{-12}$, and $0.09x10^{-12}$ m/s, respectively which were lower than those of Portland cement concrete NC(0.65) (water permeability of $0.59x10^{-12}$ m/s, using OPC of 300 $kg/m^3$).

5.1.8 CR-FM and CR-PA could be used as a binder for concrete facing brick on producing high-strength and high resistance to moisture penetration according to ASTM C1634 (2010) for normal weight classification of concrete facing brick. In addition, concrete brick made from CR-FN binder was classified as moderate-strength concrete building brick according to ASTM C55 (2010) for normal weight classification of concrete building brick. The CR-FM and CR-PA concrete bricks had the compressive strengths of 26.5, 27.4 and 33.9, 32.6 MPa at 28 and 90 days, respectively.

5.1.9 The mixture of calcium carbide residue and pozzolanic materials could not only be used as a new binder for concrete and concrete brick, but could also help reduce the environmental problems due to reducing the production of Portland cement and disposal of calcium carbide residue and pozzolanic materials.

## 5.2 Future Works

5.2.1 Further studies on plastic shrinkage in plastic stage of fresh CR-pozzolans concrete properties, including find out the other accelerator admixture for accelerating the times for setting of the CR-pozzolans concrete.

5.2.2 Further studies on properties of hardened concrete which can be classified as short-term and long-term properties. For short-term properties, bonding between concrete and rebar should be extended to determine. For long-term properties, creep and drying shrinkage of CR-pozzolans concrete should be also determined.

5.2.3 Development of the binders from calcium carbide residue and fly ash, palm oil fuel ash, and rice husk-bark ash together for high-strength or high-performance concrete applications should be studied.

5.2.4 Development of the compressive strength of concrete brick by increasing of the compressive force application for enhancing the compaction of the binder within the mould should be mannered.

5.2.5 Cost estimation in both CR-pozzolans concrete and CR-pozzolans concrete brick should be compared with Portland cement concrete and concrete brick.