# CHAPTER 5
# CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Conclusions

The daylight in the atrium building was investigated through the experimental measurements under real skies in the tropics and the simulation software was based on the ray-tracing method. Experimental results show that the conditions of the sky and the position of the sun influence the daylight illuminance in the atrium significantly. On different floors (upper floors or lower floors), the distribution patterns of the daylight are distinct. The experimental results also show that the daylight near the well edge is dominated by the direct component of the transmitted daylight while the daylight near the rear walls is dominated by the internally reflected component of the daylight. The simulation software was validated against the experimental measurements. The calculation results agree quite well with the measurements.

The simulation study was performed to assess the daylight illuminance and its distribution. The daylight illuminance levels for the four zones of the atrium building illustrated that there was sufficient daylight illuminance for the circulation area throughout the day and all year-round. The upper floors ($8^{th}$–$10^{th}$ fl.) have a large variation of daylight over the space. At 2m. from the light well edge, UDI values are much low (14%) due to the excessive daylight. On the other hand, the UDI values are higher (90%) at 4-10 m. shown as effective daylighting zones. For the middle floor ($7^{th}$ fl.) indicate effective daylighting zones only at 2m. apart from the light well. On the lower floors ($1^{st}$-$4^{th}$ fl.), UDI values less than 20% thought out a year. Thus, ineffective areas need to add artificial lamps in order to meet daylight requirement. The maximum WI values for effective daylight use is about 1.6 (about top fourth floor of atrium) in all zones (north, south, east and west). Every zone of atrium has higher UDI values when the sun stay northern hemisphere.

The relationships between the daylight illuminances in the adjoining space were derived into the ratio of interior to exterior daylight illuminance in order to adapt for free-hand calculation. Separating the percentage of the beam and the diffuse illuminance ratio resulted in a rapid evaluation of daylight quantity for tropical regions. The ratio of interior

to exterior diffuse illuminance (Edi/Edo) of shallow atrium (WI=0.4) is about 13% and middle to tall atrium (WI>1.6) less than 1%. The ratio of interior to exterior beam illuminance (Ebi/Ebo) of shallow atrium (WI=0.4) is about 7% and middle to tall atrium (WI>1.2) less than 1%

## 5.2 Recommendations for future research

Taking advantage of the daylight inside the atrium building in the tropical region should not be concerned only with the interior daylight distribution but also the thermal load and the glare in the atrium space. Intensive daylight illuminance in the tropics causes a glare situation on the top floor of the atrium buildings, so shading device should be designed properly for the upper floor of the atrium space. In order to introduce more daylight to the lower floor.