# INDOOR AIR QUALITY IN UNIVERSITY

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In the previous studies, indoor air quality in classroom was found to affect learning efficiency and health status of students by questionnaire investigation. Air pollutants and environmental factors such as carbon dioxide (CO), temperature, relative humidity (RH), ozone ($O_3$), particulate matter (PM), fungal bioaerosol, bacterial bioaerosols and ventilation rate were the factors of concern. It was indicated that poor air quality in office building decreased workers' working efficiency in the range of 6%-9%. The ventilation type of classroom in university is similar to office buildings. However, little studies concerned this issue. Therefore, the purpose of this study is to investigate the indoor air quality in the classrooms in a university.

We selected 9 classrooms in 2 academic buildings (Building A, building B) in a university from September to December in 2008. $CO_2$, CO, Relative Humidity, temperature (Indoor Air Quality Meters, TSI INCORPORATED, USA), wind speed, ventilation rate (TSI INCORPORATED, USA), O3 (Ozone Monitor, BUD INDUSTRIES, USA), $PM_{10}$、$PM_4$、$PM_{2.5}$、$PM_1$ (Dust Trak, TSI INCORPORATED, USA), and ultrafine particles (P-Trak, TSI INCORPORATED, USA) were measured indoor and outdoor simultaneously before and after mechanical ventilation turning on in the morning and noon. Airborne bacteria and fungi were also sampled by impaction method and cultured in Malt Extract Agar and Tryptic Soy Agar, respectively.

Our results showed that the concentration of $PM_{10}$, $PM_4$, $PM_{2.5}$, $PM_1$, fungal bioaerosols and bacterial bioaerosols before mechanical ventilation turning on were higher than it turned on. For $CO_2$ concentration, 9.52% and 33.33% samples in building A and building B, respectively, were exceeded the recommendation of indoor air quality from Taiwan Environmental Protection Agency. In addition, $O_3$ concentration of building B was significant higher than building A (p=0.0169). A lot of plants nearby building B might be the reason.

Table1. Failure rate of building A, and B when comparing with Taiwan EPA's guideline of indoor air.

| | Building A(n=21) | Building B(n=6) |
|---|---|---|
| CO | 0% | 0% |
| $CO_2$ | 10% | 33% |
| $PM_{2.5}$ | 33% | 0% |
| $PM_{10}$ | 14% | 0% |
| $O_3$ | 0% | 0% |
| Fungi | 0% | 0% |
| Bacteria | 0% | 0% |

Table2. Before and after turning on mechanical ventilation in classrooms.

| | Before | After | |
|---|---|---|---|
| | Median | Median | p-value |
| Temp.(℃) | 22 | 22 | 0.0379* |
| RH(%) | 64 | 64 | 1.0000 |
| CO(ppm) | 4 | 4 | 0.5071 |
| $CO_2$(ppm) | 535 | 511 | 0.7239 |
| Wind Speed(m/s) | 0.03 | 0.10 | 0.0004* |
| Ultrafine(PT/$cm^3$) | 11360 | 13300 | 0.3314 |
| $PM_1$(μg/$m^3$) | 530 | 440 | 0.5962 |
| $PM_{2.5}$(μg/$m^3$) | 550 | 500 | 0.6270 |
| $PM_4$(μg/$m^3$) | 600 | 500 | 0.5961 |
| $PM_{10}$ (μg/$m^3$) | 660 | 600 | 0.5961 |
| $O_3$(ppb) | 2 | 1 | 0.3745 |
| Fungi (CFU/$m^3$) | 90 | 60 | 0.0422* |
| Bacteria (CFU/$m^3$) | 206 | 146 | 0.1331 |

* p<0.05 (Wilcoxon Sign Rank Test)

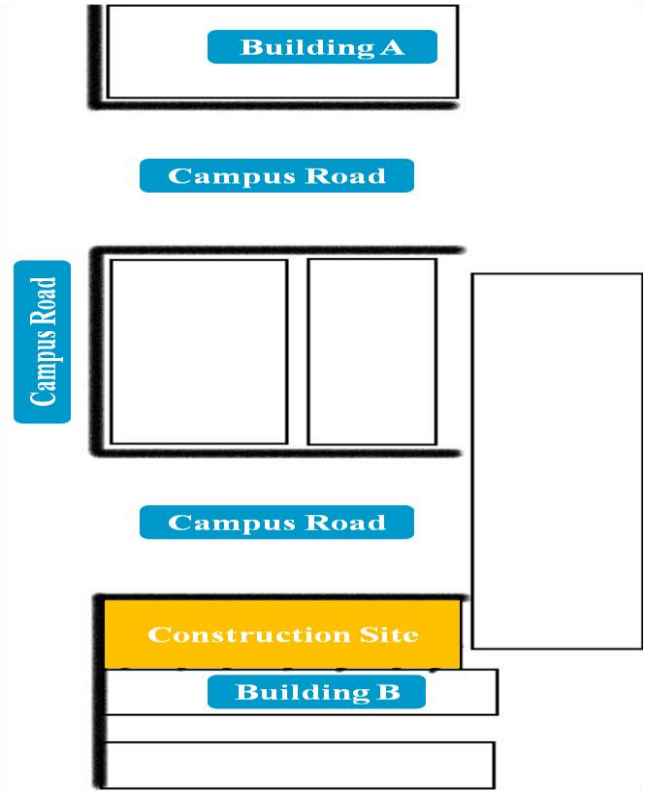


Figure 1. floor layout