

Field-testing results and performance analysis of a real IEC water chiller system

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Outline

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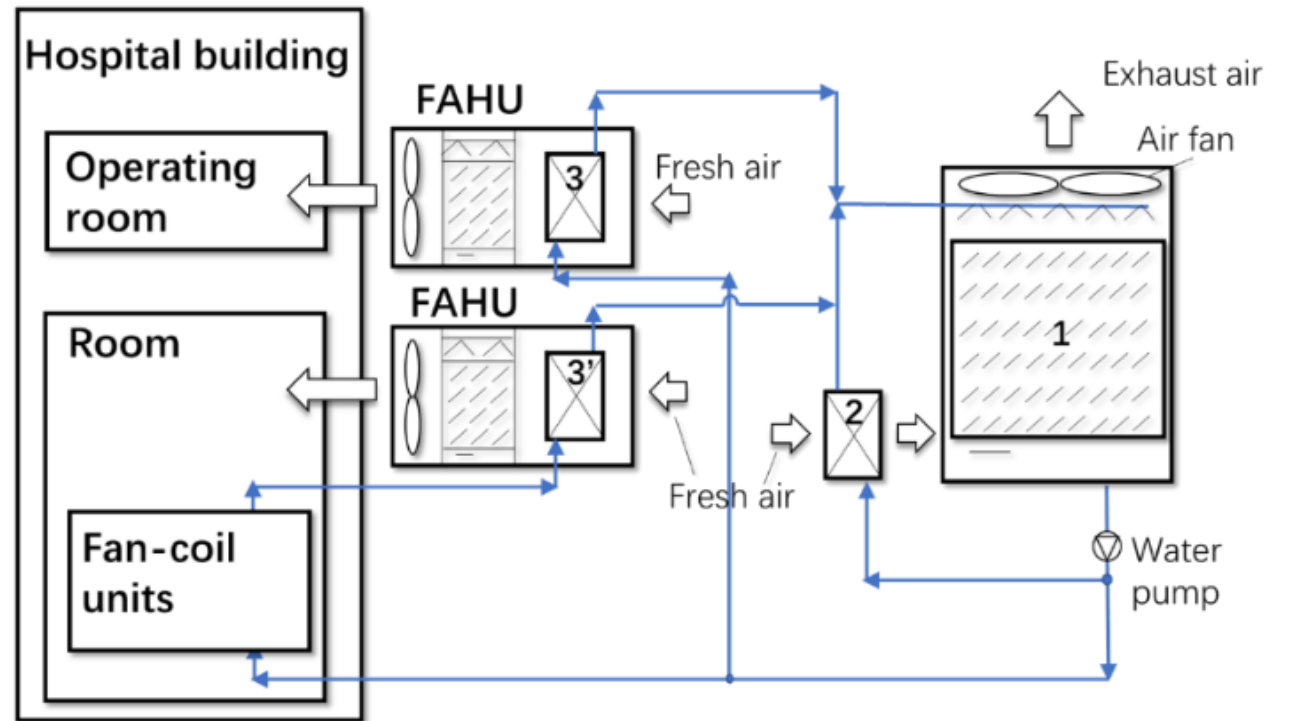
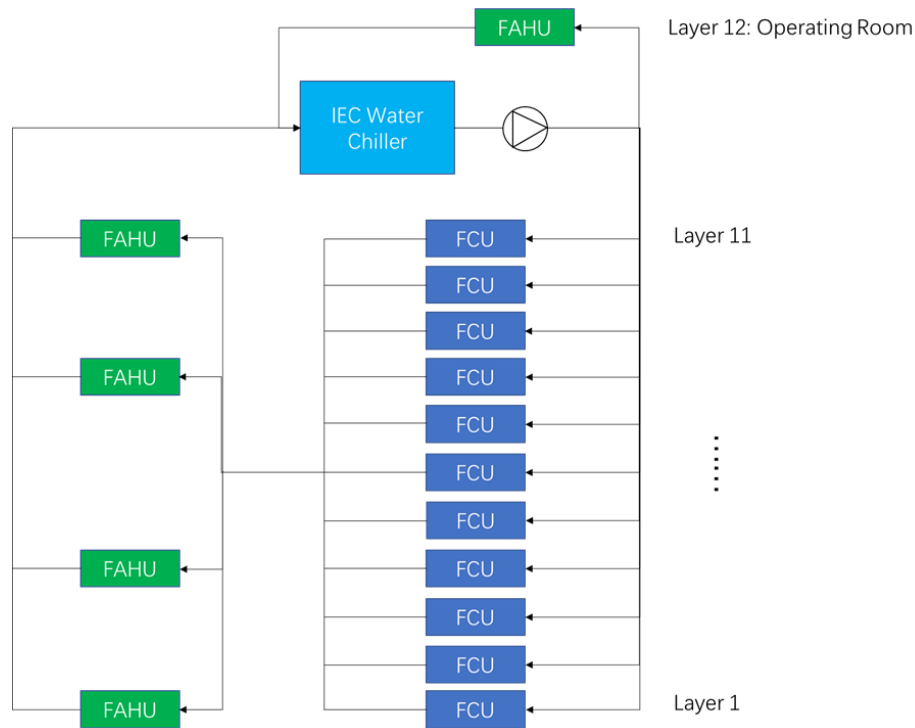
Building description

- **Serial indirect evaporative water chiller system**
- **Xinjiang Changji People's Hospital**
 - **Location:** the Xinjiang Uygur Autonomous Region, China
 - **Developed date:** in 2012
 - **Building area:** 22 289.58 m²
 - **Atmospheric pressure:** 94.42 kPa
 - The building has 12 floors and about 427 rooms, the 12th floor is operating rooms, and other floors are common room, the design load is about 700 kW.



System description

- The air conditioning system uses **six indirect evaporative water chillers** in parallel as the cooling source,
- For the operating rooms use all fresh air system, the water passes through the FAHU directly to produce the cooling fresh air required by the room.
- For the common room, cold water from the padding tower passes through the FCU and FAHU in series to increase the difference of the temperature of the inlet water and the output water.



System description

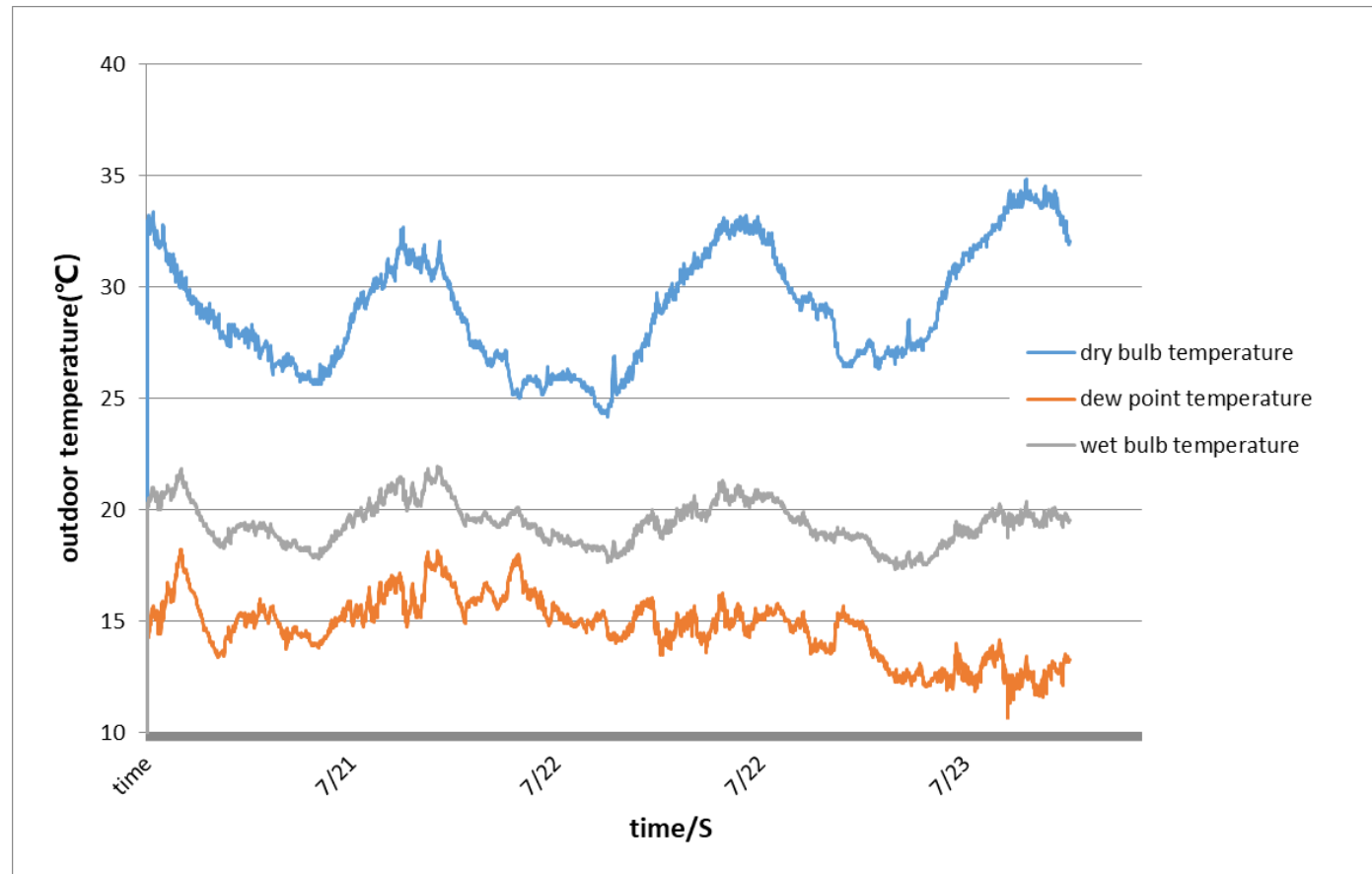
- Equipment data of the system

AHU	value	quantity
AHU- operating room	SZHJ-III_28: air flow : 28000m ³ /h cooling capacity: 94 kW	1
AHU-1	SZHJ-III_33: air flow : 33000m ³ /h cooling capacity: 100 kW	2
AHU-2	SZHJ-III_39: air flow : 3900m ³ /h cooling capacity: 117 kW	2

FCU	value	quantity
FCU-1	air flow : 300m ³ /h cooling capacity: 630 W	101
FCU-2	air flow : 430m ³ /h cooling capacity: 860 W	186
FCU-3	air flow : 600m ³ /h cooling capacity: 1155 W	101
FCU-4	air flow : 720m ³ /h cooling capacity: 1385 W	39
Indirect evaporative water chiller	Water flow rate: 160 m ³ /h cooling capacity: 1860kW	1

Outdoor air condition

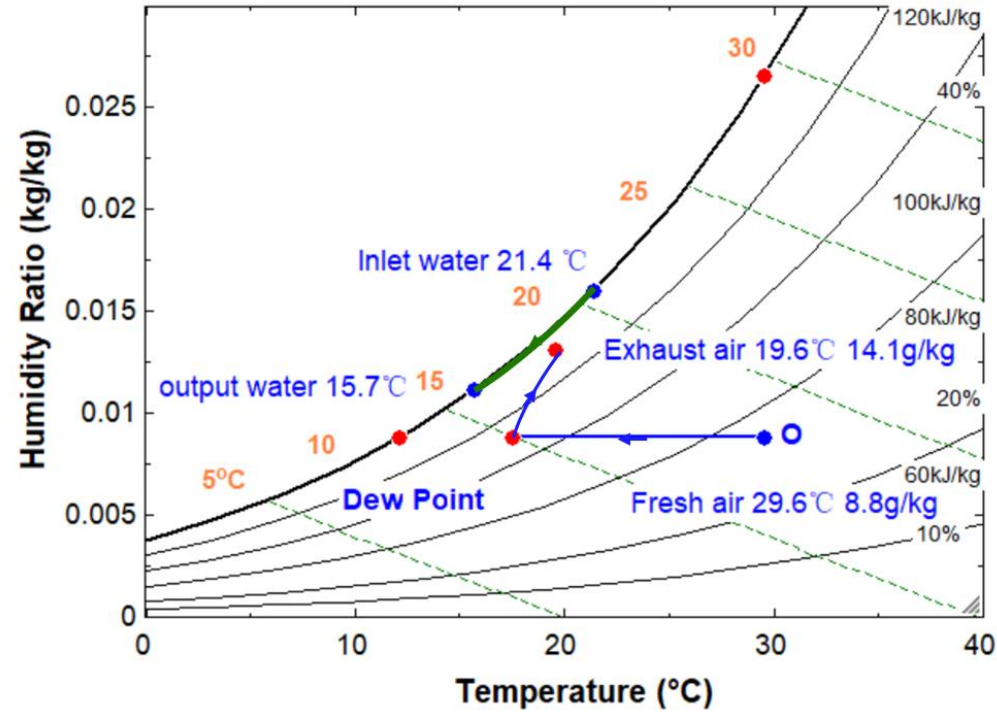
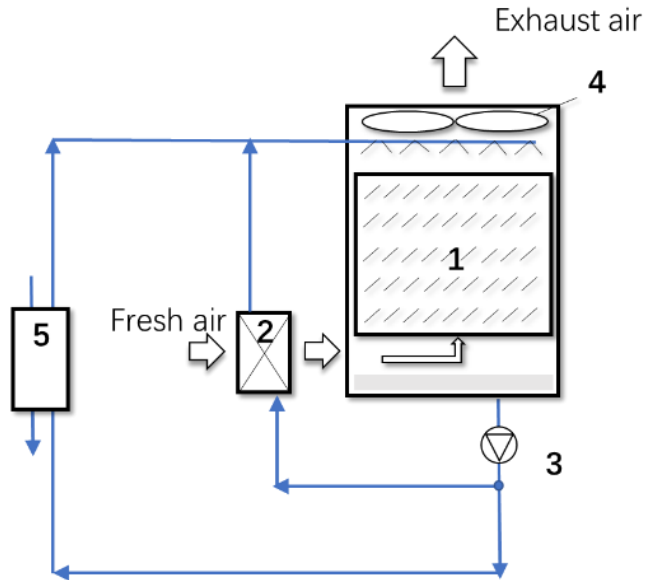
- Testing outdoor air condition in July.
- The outdoor air temperature of the indirect evaporative chiller varied between 24~35°C, the outdoor wet bulb temperature was between 18~22°C, the outdoor dew point temperature was between 11~19°C.



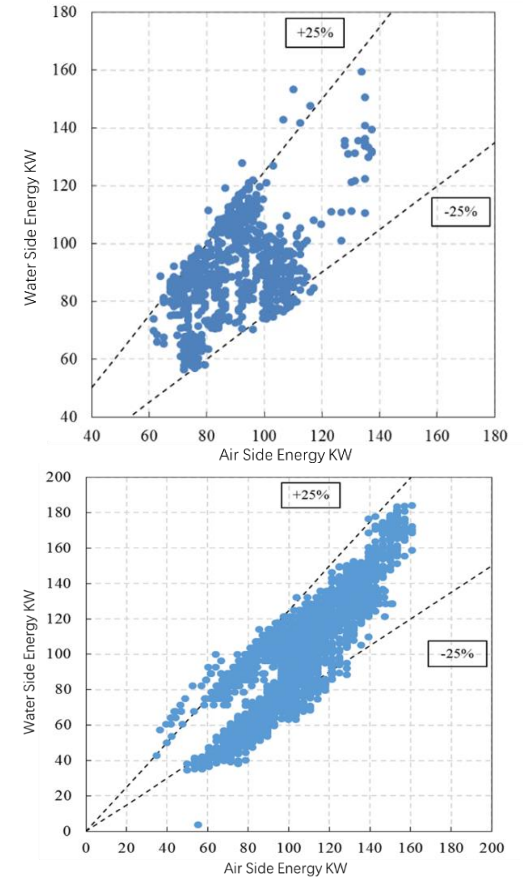
tested outdoor air condition and out water temperature of the chiller

Field-testing performance of the system

- the details of the air and water process in water chiller



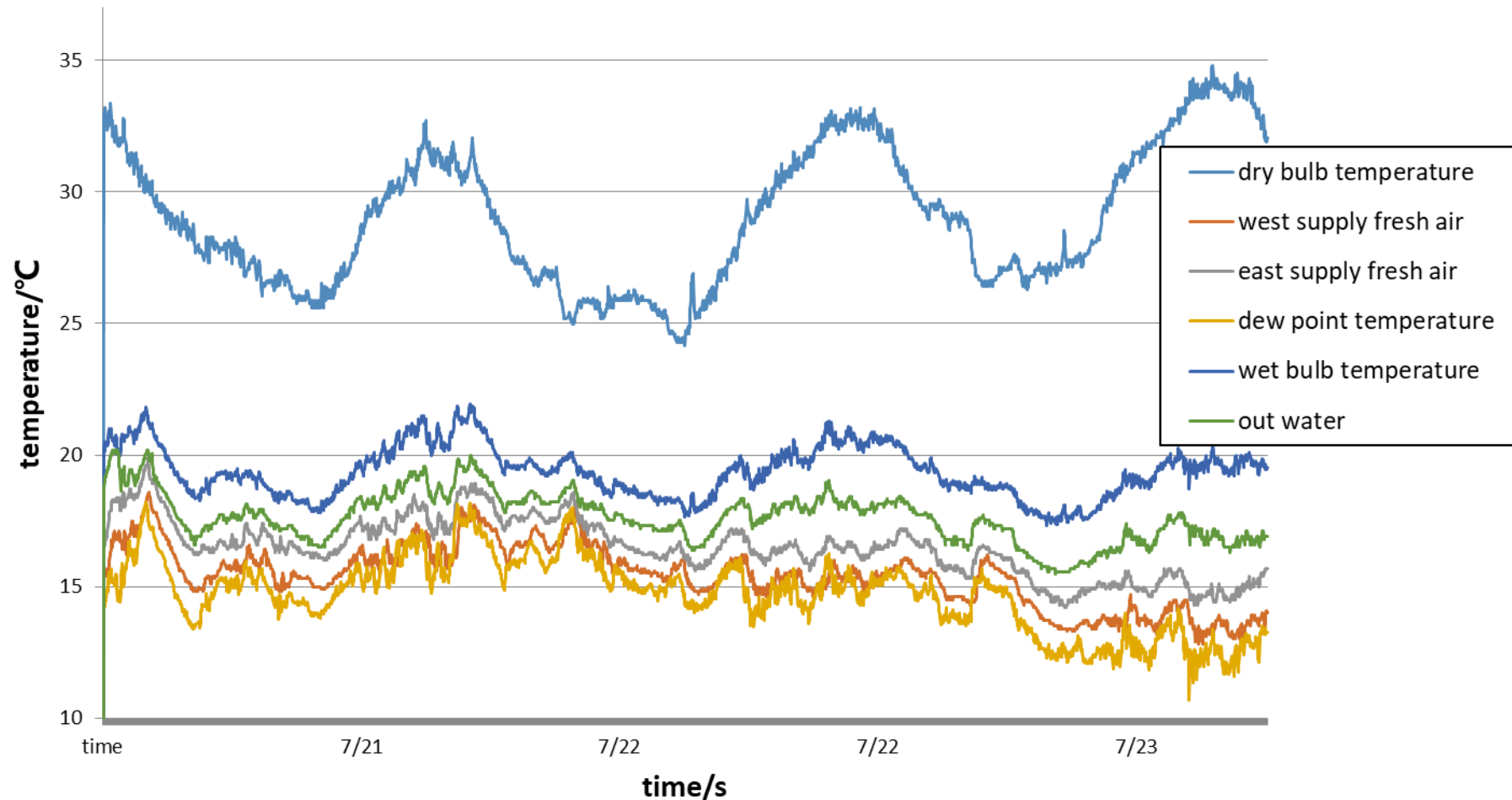
process of the typical tested working condition



heat balance of the equipment
 (a) Single water chiller heat balance
 (b) Single FAHU heat balance

Field-testing performance of the system

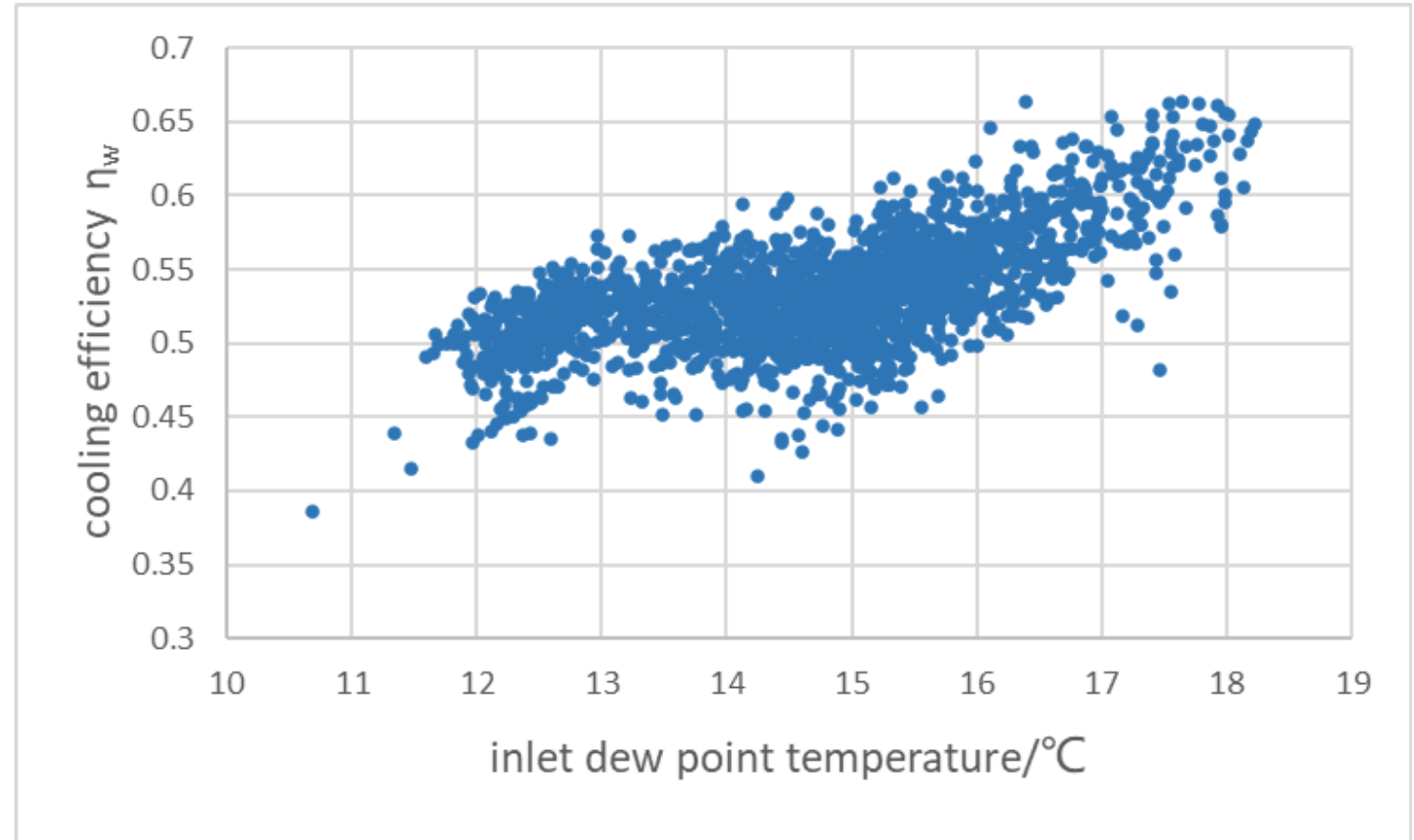
- Typical working condition of the system
- The produced cold water temperature is 16~19°C, 2°C~3°C lower than the wet bulb temperature of the inlet air.



Field-testing performance of the system

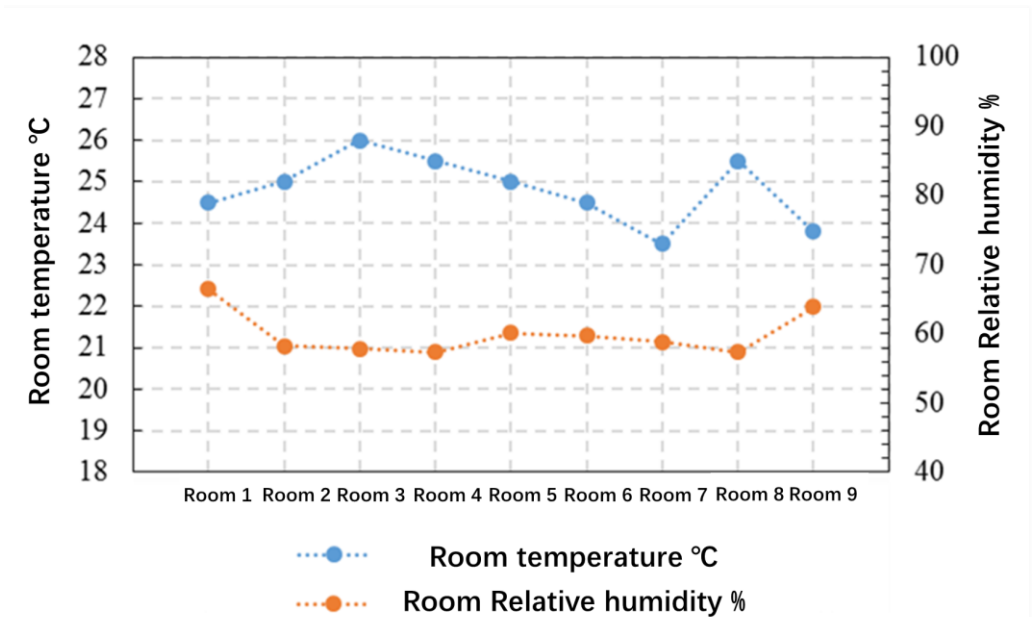
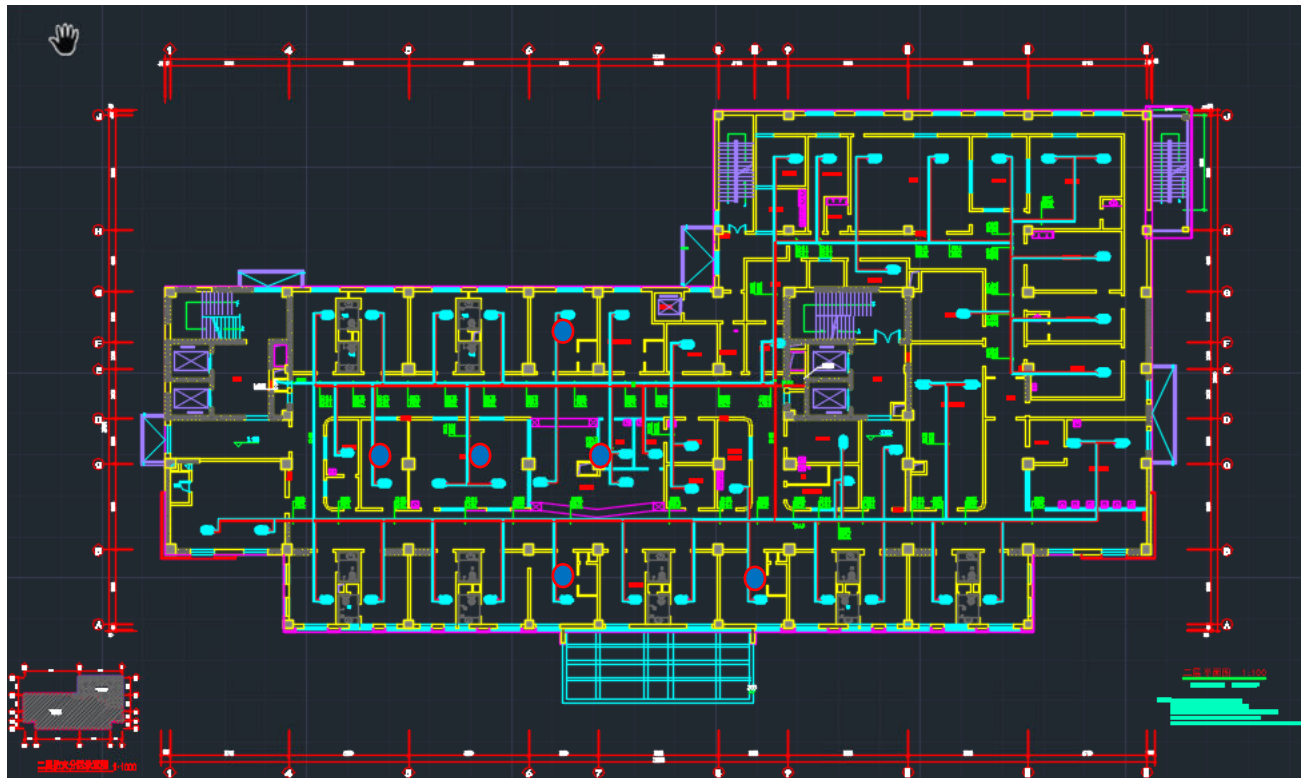
- The cooling efficiency η_w of the indirect evaporative chiller during the testing period is varied between about 0.4-0.7 with the changing inlet air condition.

$$\eta_w = \frac{t_{w,r} - t_{w,out}}{t_{w,r} - t_{dp,0}}$$



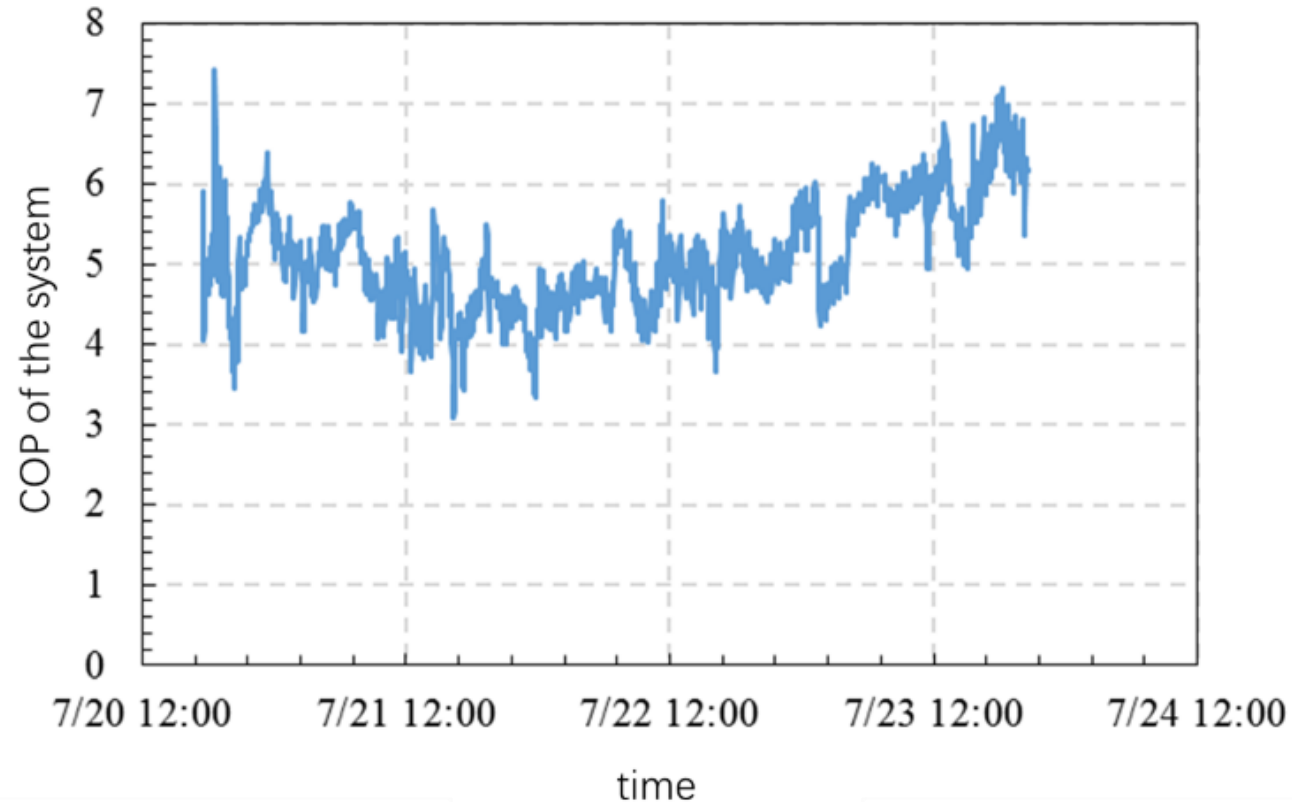
Field-testing performance of the system

- Terminals: the indoor air temperature is from 23°C to 26°C, and the room relative humidity is from 55% to 65%, which are suitable air conditions for the rooms of the building



Field-testing performance of the system

- The COP_s of the system is defined as the indoor sensible heat load divided by the system energy consumption, including the chiller energy consumption, FCU energy consumption, FAHU energy consumption, and transport energy consumption.
- COP_s can reach 7.4



Conclusion

- An application of serial indirect evaporative water chiller system was introduced.
 - The field-testing data was from a hospital which developed in 2012, Xinjiang Province, China.
 - The produced cold water temperature of the system was 16-19°C, which between the inlet dew point temperature and the wet bulb temperature.
 - The cooling efficiency varied between about 0.4-0.7 with the changing inlet condition.
 - The COP of the indirect evaporative chiller reached 10-12, and the COP of the system reached 4.5-6, which saved about more than 35% of electricity compared with ordinary air conditioning systems with a system COP about 2-3.
 - The room temperature is 23-26°C, and the relative humidity is 60-70%.
- The field-testing data also found the limitation of the system operation: the cooling load of the terminal rooms is lower than the design condition, the performance of the indirect evaporative water chiller system was not fully utilized, the energy efficiency ratio of the system can be further improved.

**Thank you for your
attention**
