Effect of Corridor Design on Energy Consumption for School Buildings in the Cold Climate

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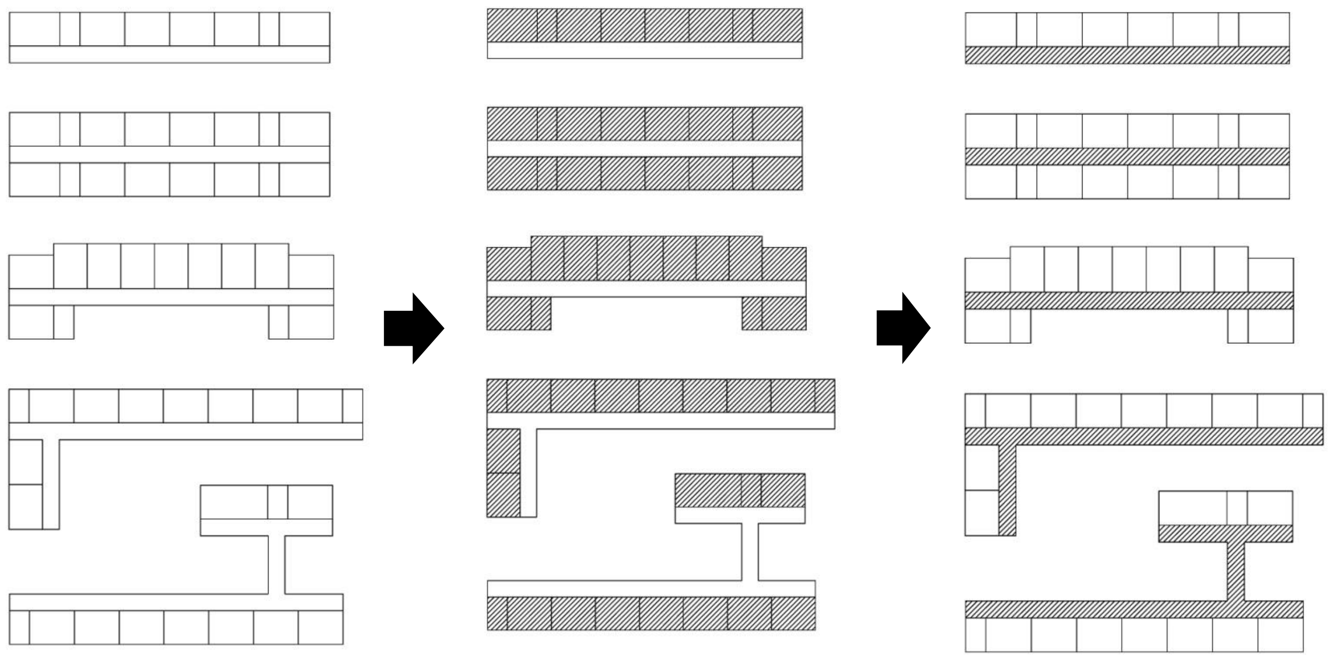
Corridor: traffic and communication space in school buildings



Typical plan of school buildings → Classroom unit → Corridor space

Space types of corridor design

Type A:
Double-sided corridor school building

Type B:
One-sided enclosed corridor school building

Type C:
One-sided open corridor school building

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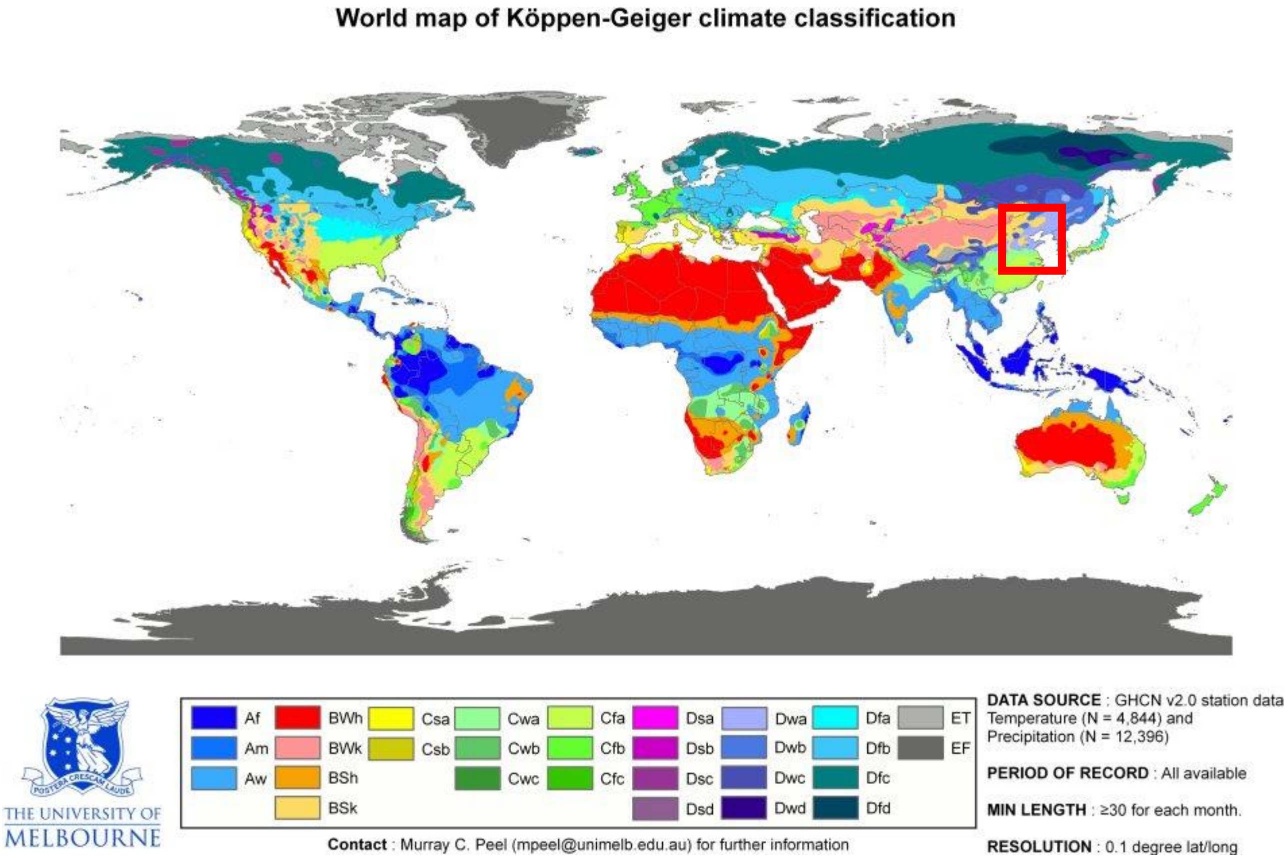


The cold climate in China:

Dwa:

Humid continental climate;

Cold and dry winter;

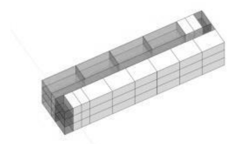
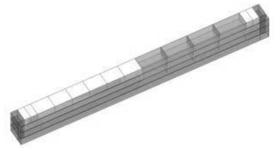
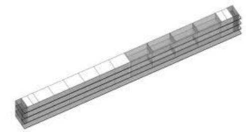
Hot and humid summer （warmest month average above 22℃ ）

Research questions:

- Which corridor design measures can influence the energy performance of school buildings in cold climates more effectively?

- To what extent would the combination of corridor strategies provide energy-saving?

School building models for three types of corridors

	Double-sided corridor (Type A)	One-sided enclosed corridor (Type B)	One-sided open corridor (Type C)
Configuration.			
Floor plan.			

N | C General Classroom | Specialized Classroom | Bath/Water/Tech | Stairs | Corridor

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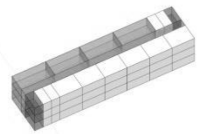
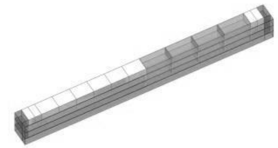
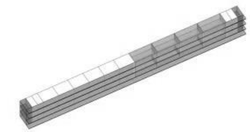
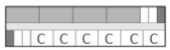
Characteristics of corridor space

Orientation (Spatial location).	0°*, 90°,180°, 270°
Corridor width	1.5m*, 2.4m[a], 3m[a]
Temperature control.	16℃-26℃*, 14℃-28℃, 12℃-30℃
Wall insulation.	0.35*,0.30,0.25 [b] W/m^2K
Roof insulation.	0.49*,0.35,0.15 [b] W/m^2K
Glazing type.	Single glass, double glass*, triple glass, double low-e glass
Window to wall ratio of external surfaces.	20%,30%,40%*
Mechanical ventilation.	10, 19*, 30 $m^3/h{\bullet}p$
Infiltration.	0.75, 1.0*, 1.5 ac/h

* The base case settings of the reference model.
[a] Mean value of different periods of school design in China from the 1980s to the present (Wang, 2007).
[b] Best practice building from Designbuilder (Designbuilder, 2014).

	Double-sided corridor (Type A)	One-sided enclosed corridor (Type B)	One-sided open corridor (Type C)
Configuration.			
Floor plan.			
N	C General Classroom	Specialized Classroom / Bath/Water/Tech	Stairs / Corridor
Orientation.	0°*, 90°,180°, 270°	0°*, 90°,180°, 270°	0°*, 90°,180°, 270°
Corridor width	1.5m*, 2.4m[a], 3m[a]	1.5m*, 2.4m[a], 3m[a]	1.5m*, 2.4m[a], 3m[a]
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Window to wall ratio of external surfaces.	20%,30%,40%*	20%,30%,40%*	20%,30%,40%*
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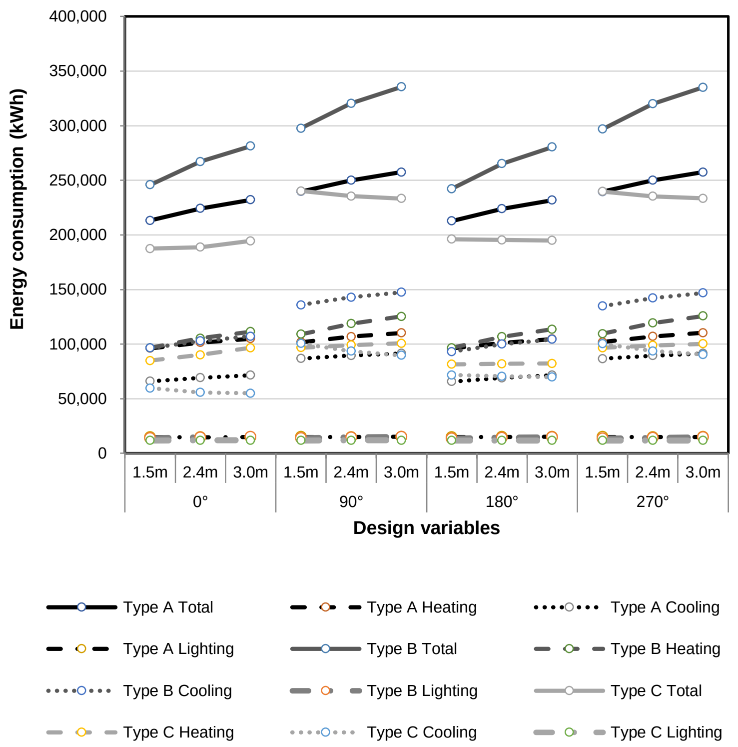
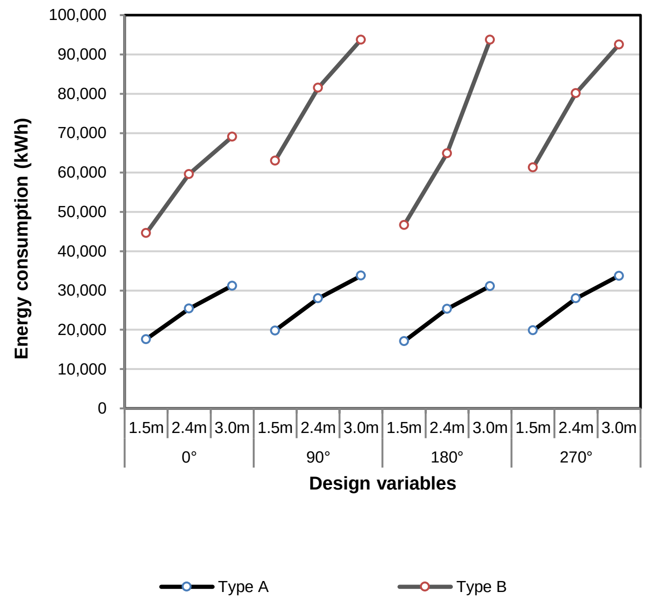
Infiltration.	0.75, 1.0*, 1.5 ac/h	0.75, 1.0*, 1.5 ac/h	-

Forms and orientations

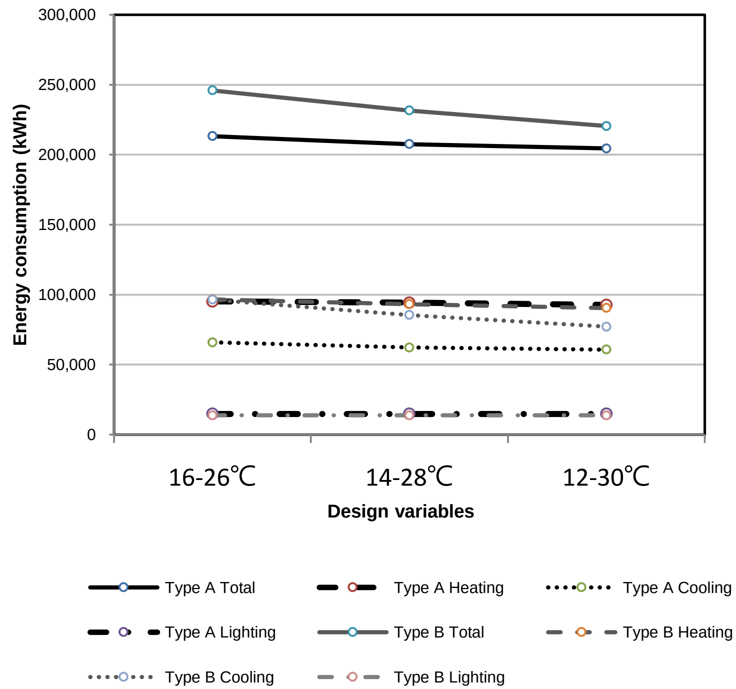


Annual energy consumption of school buildings for different forms and orientations

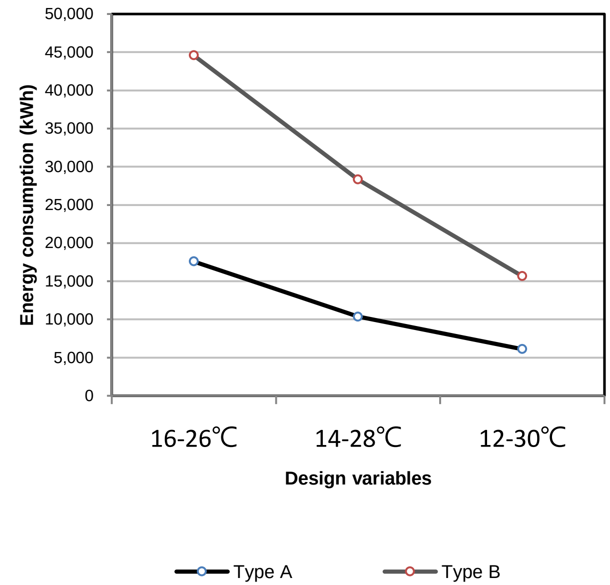


Annual energy demand of corridor space for different forms and orientations

Temperature control



Annual energy consumption of school buildings for different temperature control



Annual energy demand of corridor space for different temperature control

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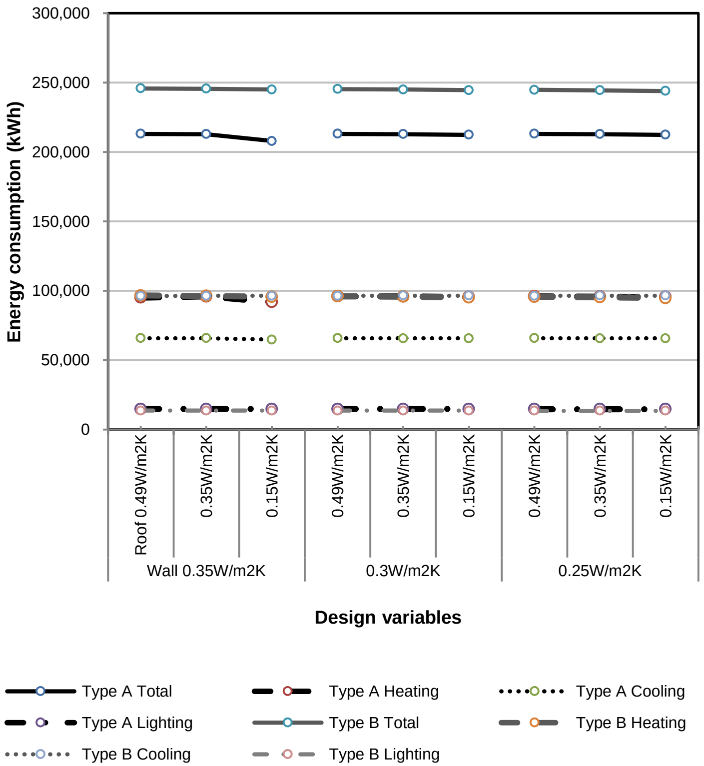
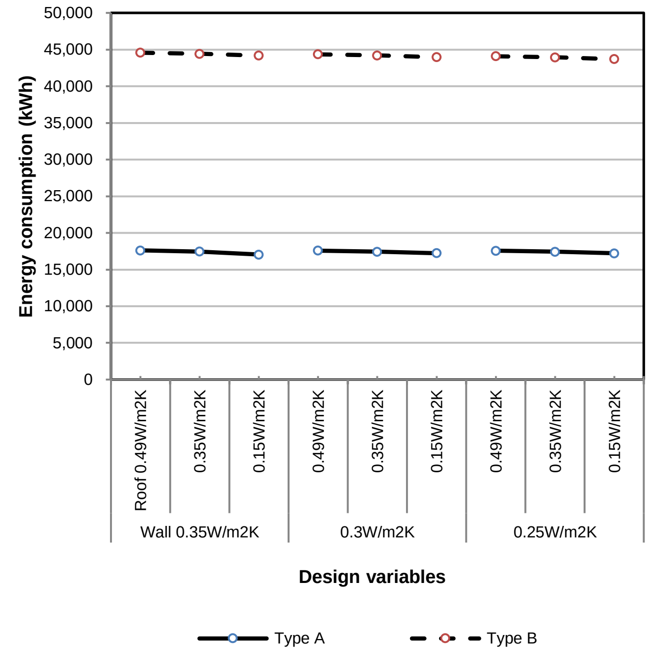
Opaque envelope designs



Annual energy consumption of school buildings for different opaque envelope designs



Annual energy demand of corridor space for different opaque envelope designs

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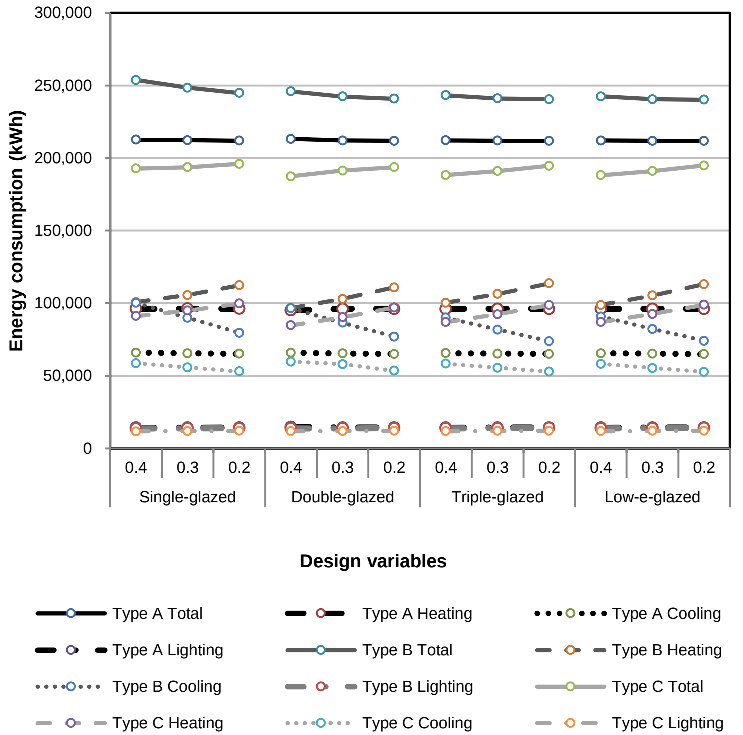
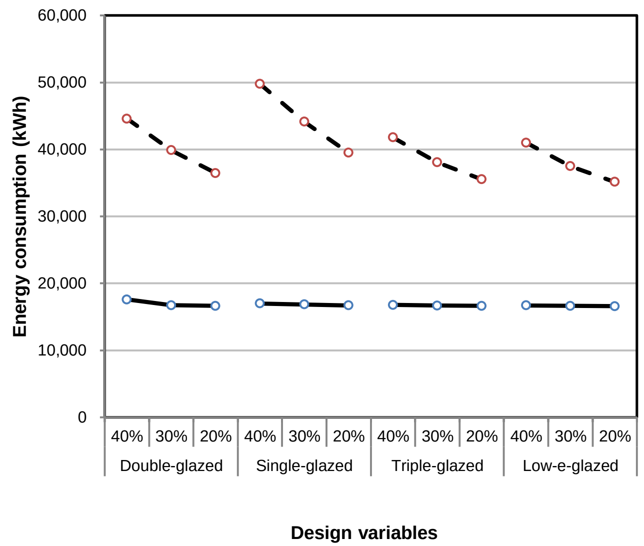
Glazing



Annual energy consumption of school buildings for different glazing



Annual energy demand of corridor space for different glazing

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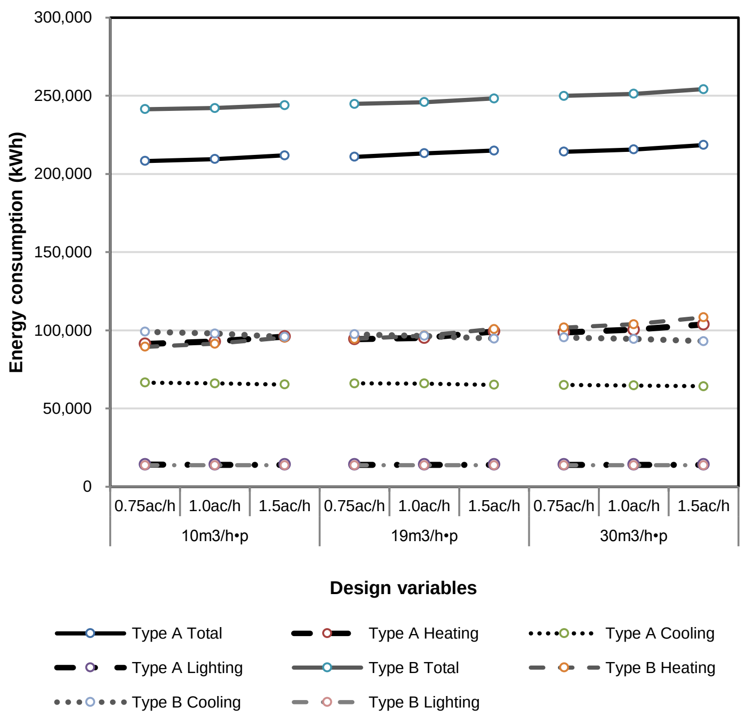
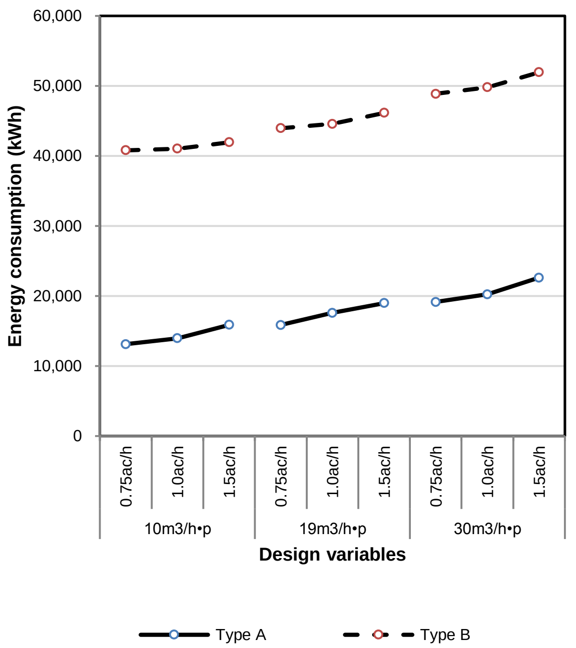
Ventilation and infiltration

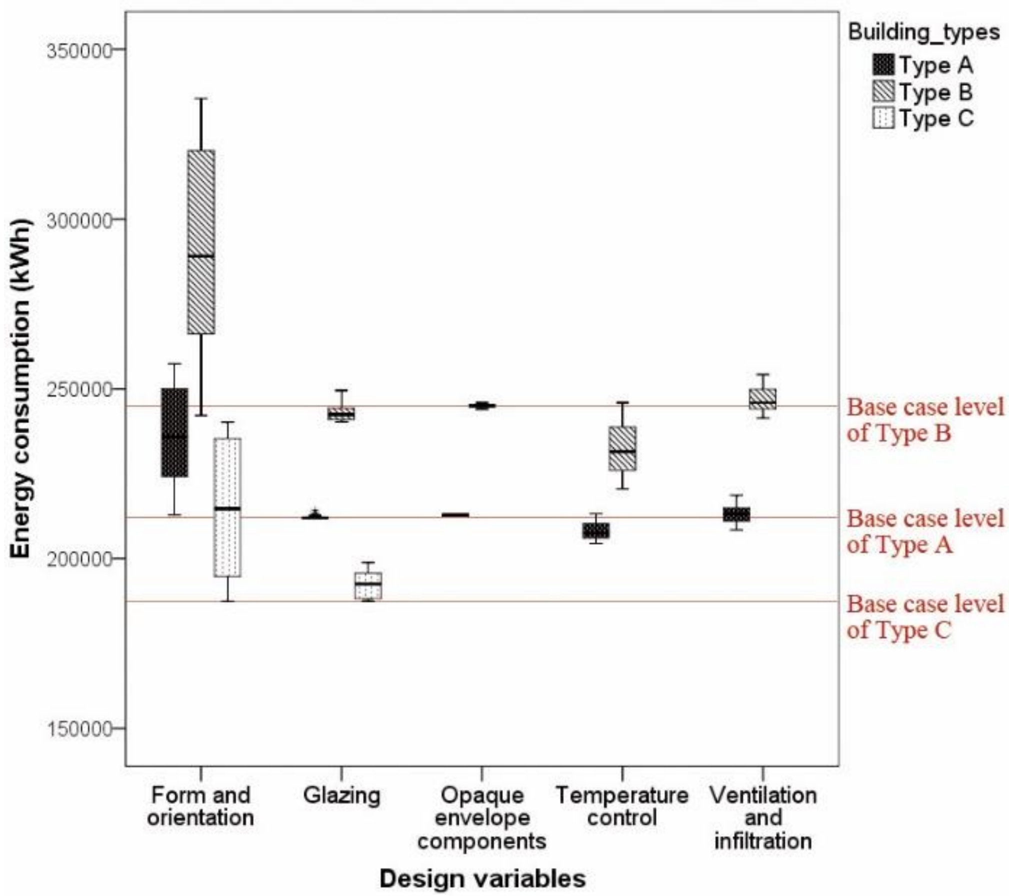


Annual energy consumption of school buildings for different ventilation and infiltration

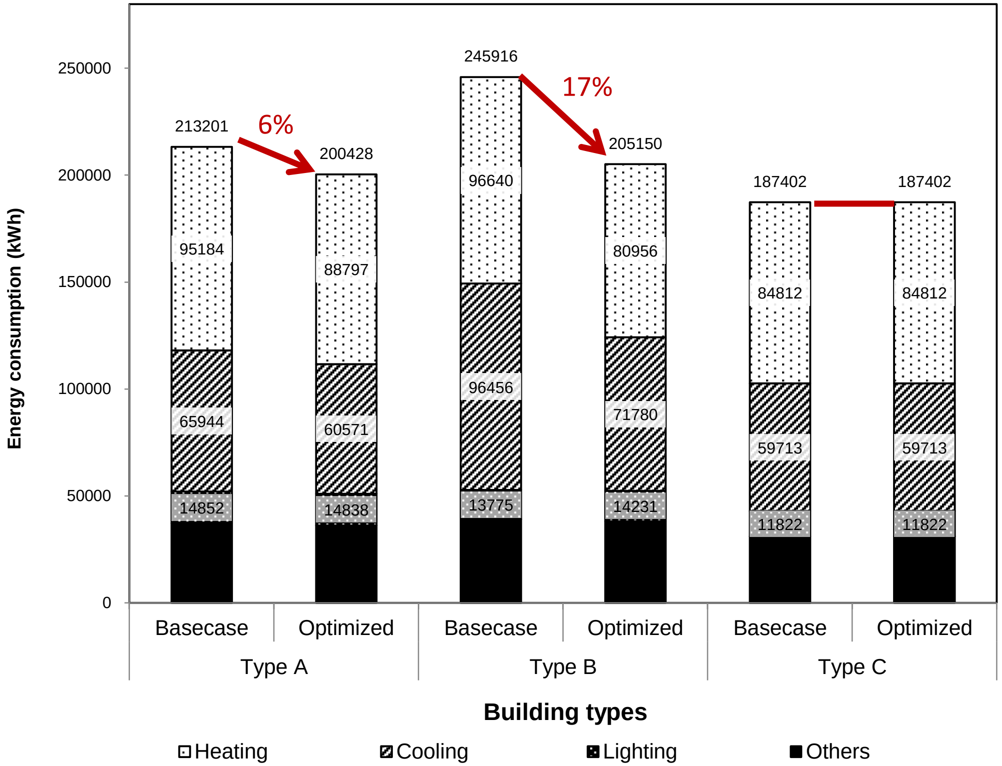


Annual energy demand of corridor space for different ventilation and infiltration

Sensitivity analysis



Integration of corridor design strategies



Comparative energy analyses of the optimized design and the base case design for school building models.

Conclusion

- Type C consumes the least energy annually while Type B has the highest energy demand.
- Form and orientation of corridors can significantly affect the total building energy consumption. Buildings with 0°and 180°rotation angle perform better than other orientations. Narrow corridors have the best performance for Type A and B while the effect is only marginal for Type C.
- Corridors equipped with a 20% WWR of low-e double glazing results in the highest energy-savings for both Type A and B. For Type C a double glazing with a 40% WWR has the lowest energy demand.
- The design with the widest temperature range and the lowest ventilation and infiltration rates can achieve the minimal building energy consumption.
- The design of the opaque envelope component for corridors has little effect on the energy demand.

Conclusion

- Finally, the integration of the corridor design solutions offers a saving in total energy by around 6% and 17% for Type A and B respectively. For Type C, the base case has the best energy performance.

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Thanks for your attentions!

○ Information

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