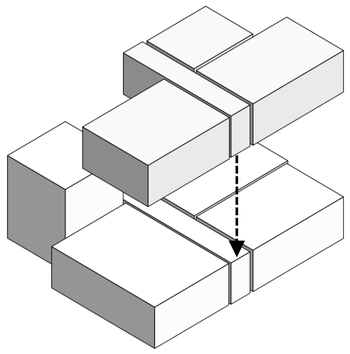
Background / Purpose / Methodology

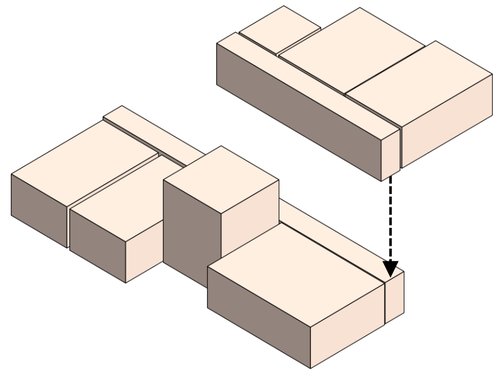
【Background】

- The zero energy building (ZEB) concept has become increasingly popular.
- The goal of ZEBs is to reduce energy consumption and increase power generation through the use of photovoltaic devices.
- In order to reduce energy consumption, it is critical that optimal building shapes and materials are considered.
- The optimal building shape is one of key factors for the ZEB, an actual house is often designed empirically.

【Purpose】

- The objective of this study was to develop an optimization methodology that could be used to find an optimal shape which minimized the annual thermal load of a detached house.
- We propose a new method in which a building is divided into elements, which cannot be decomposed more, and they are combined again using optimization methodology to minimize energy consumption





【Methodology】

- The epsilon constrained Differential Evolution with Random Jumping (ε DE-RJ) was used to optimize the room arrangement of the detached house.
- Energy Plus was used to simulate thermal energy, and Radiance was used to simulate daylighting.

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Case study／Result

【Case study】

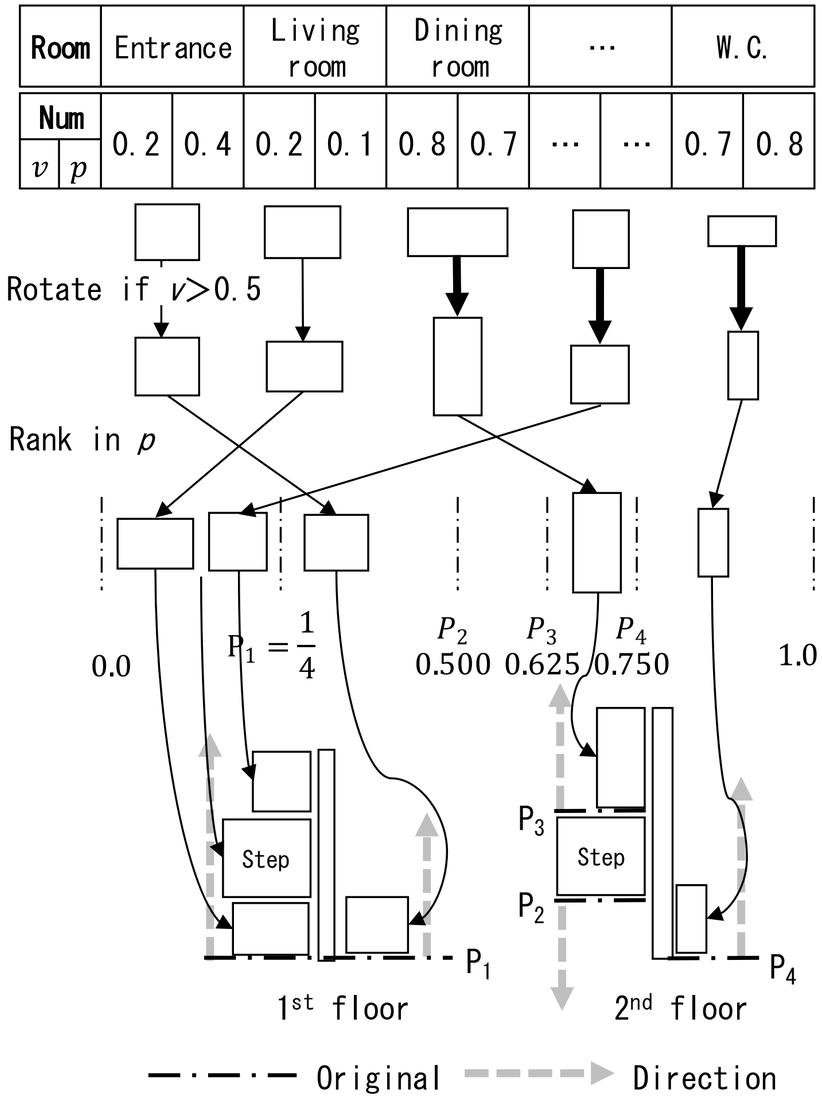
- The building for simulation is settle upon Ōtemachi, Chiyoda-ku, Tokyo. Occupancy family is constrained by 4 people.
- Formulation of decision variables to the shape of house is enable by arrangement of elemental room boxes.

Room	Size [m]	Set point Cooling / Heating	Dehumidify
Living	3.6×4.5	27 °C / 22 °C	50%
Dining	2.7×3.6	27 °C / 22 °C	50%
Kitchen	2.7×3.6	27 °C / 22 °C	50%
Bedroom	3.6×3.6	27 °C / 22 °C	50%
Sub A	2.7×3.6	27 °C / 22 °C	50%
Sub B	2.7×3.6	27 °C / 22 °C	50%
Japanese	2.7×3.6	None	None
Entrance	2.7×2.7	None	None
Step room	2.7×2.7	None	None
Bath room	1.8×3.6	None	None
Closet	2.7×2.7	None	None
W.C. A	0.9×1.8	None	None
W.C. B	0.9×1.8	None	None

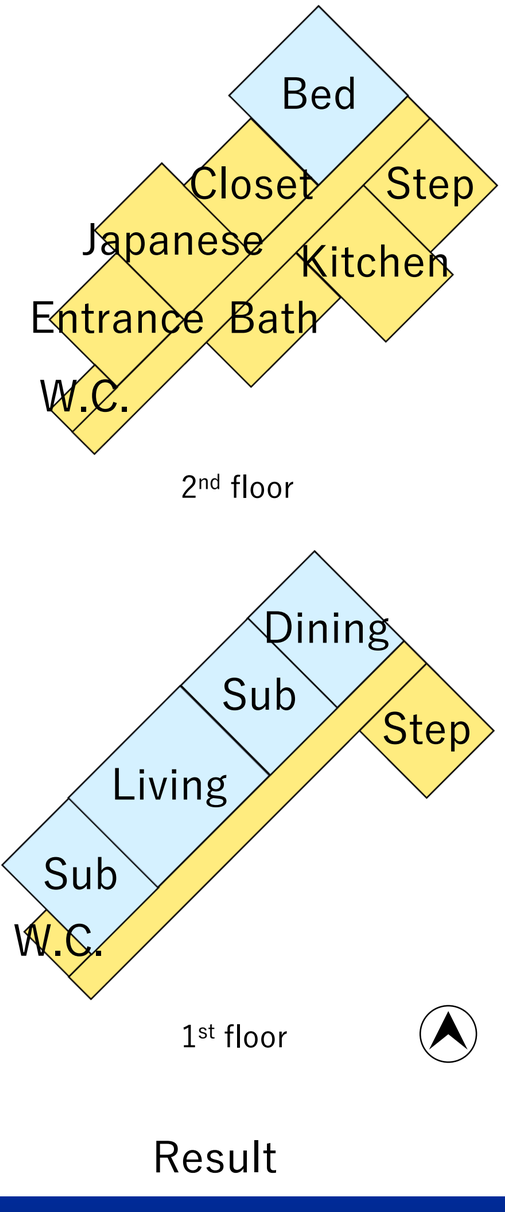
Detail of rooms

【Result】

- As the result, almost all air-conditioned rooms were located on the north-western side of the first floor to reduce the solar radiations.



Formulation of variables to house



Result

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