

CIRMM

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[Long-term Simulation of Energy and Air Quality by Considering Distribution Characteristics of Indoor Environment]

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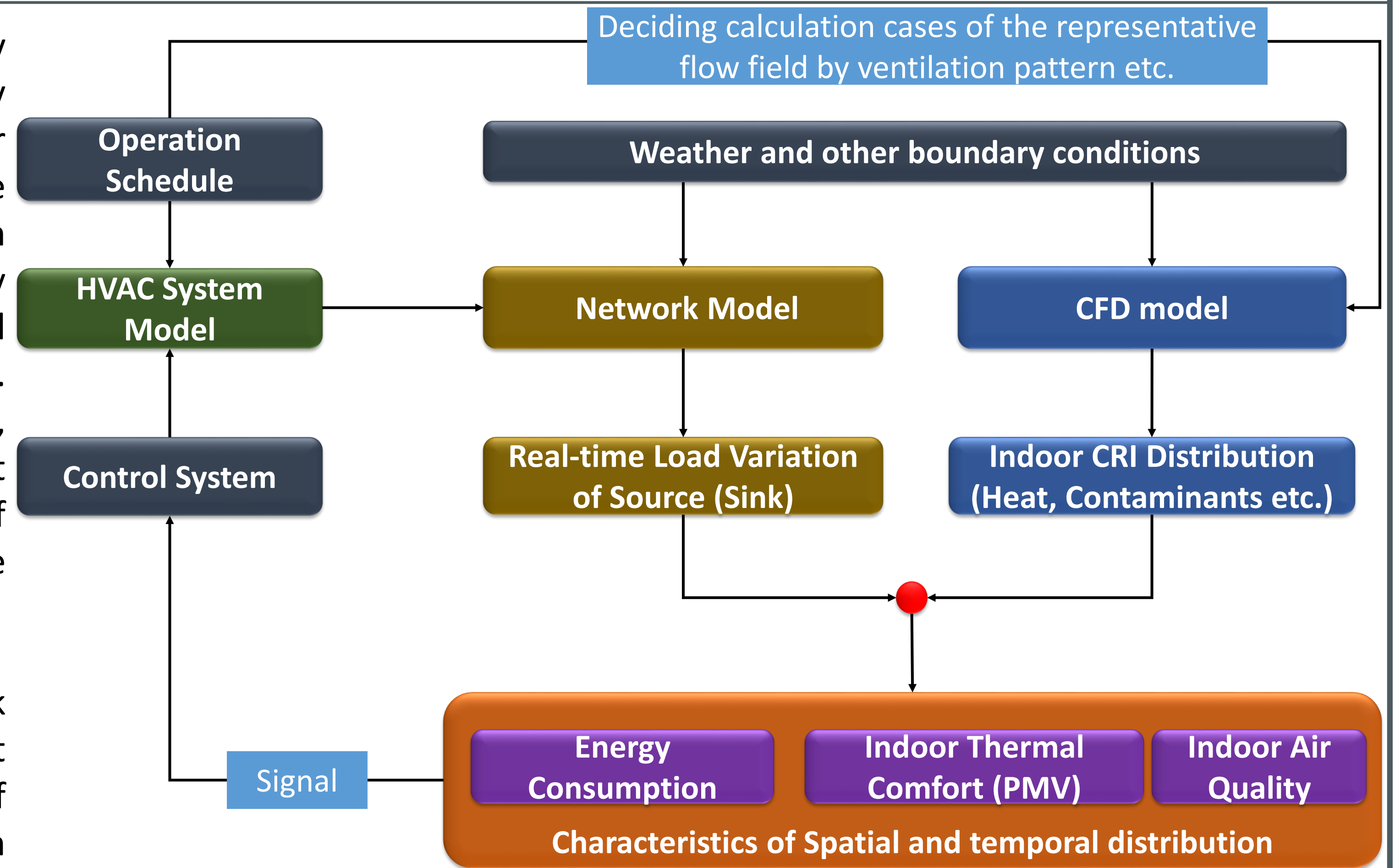
Environmental Control Engineering for Urban Architecture

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For simulating indoor environment and energy consumption in a air conditioned building, it is necessary to take both the spatial distribution of the indoor environment and the time variation into consideration. The network simulation, which assumes the indoor distribution is homogeneous, can practically calculate energy simulation of 8760 hours per year, but the spatial distribution of indoor environment is not considered. Although CFD can take account of the spatial distribution, simulation throughout the year has high calculation cost and is not put into practical use. The Contribution Ratio of Indoor Climate (CRI) is a bridge which can couples the network model and CFD model.

In this study, in order to take account of a social urgent task "Building design realizing high quality indoor environment with energy saving", a long-term simulation method of energy and air quality by considering distribution characteristics of indoor environment (Overall view simulation method) is developed.



Framework of Overall View Simulation Method

% of PMV in the comfortable range ($|PMV| \leq 0.5$) of each occupant over cooling period

North													
98.2	98.5	99.0	98.4	98.4	98.8	99.1	98.4	98.8	98.6	98.5	98.6	98.4	
97.2	98.9	97.2	98.8	96.6	98.7	97.3	98.7	96.0	98.9	97.3	98.8	96.9	98.6
97.5	98.4	97.9	98.6	98.2	98.6	98.3	98.6	98.1	98.5	98.0	98.5	97.6	98.2
South													
95.7	98.4	97.3	98.5	96.9	98.5	97.3	98.5	96.8	98.5	96.9	98.4	96.8	98.1
97.6	98.4	97.5	98.7	97.9	98.6	97.8	98.6	98.1	98.7	97.6	97.4	97.5	96.7
98.1	96.9	98.4	98.2	98.3	98.3	98.4	98.4	98.2	98.4	98.4	98.4	97.8	95.3

Each square block represents an occupant and his/her position in the room

% of CH₂O concentration not exceed the standard (83 $\mu\text{g}/\text{kg}_{\text{air}}$) of each occupant over cooling period

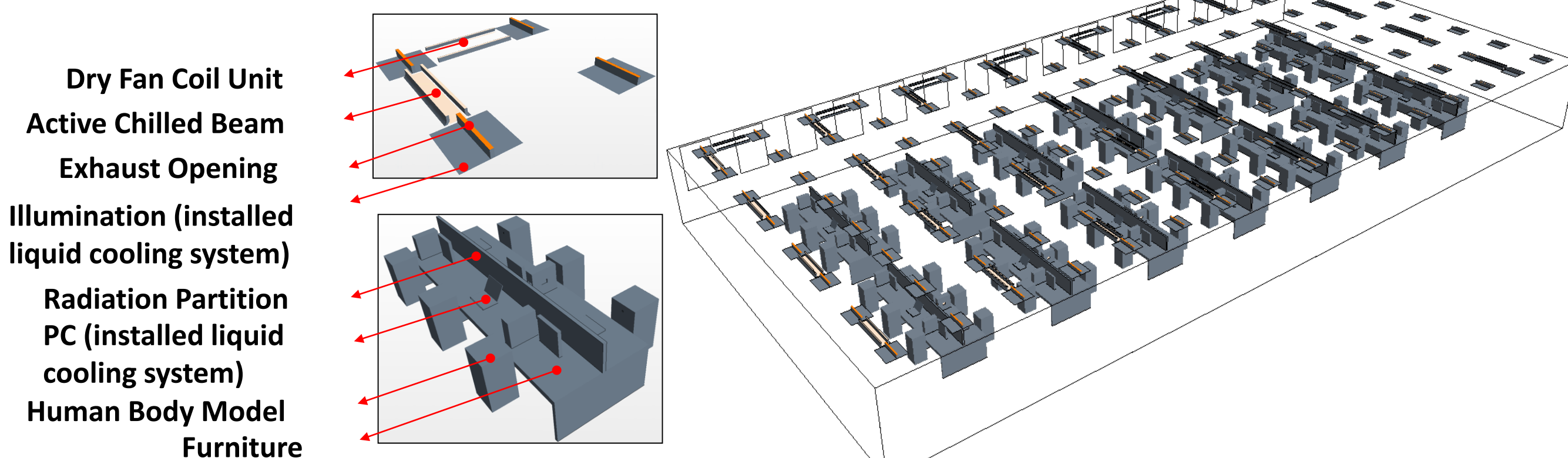
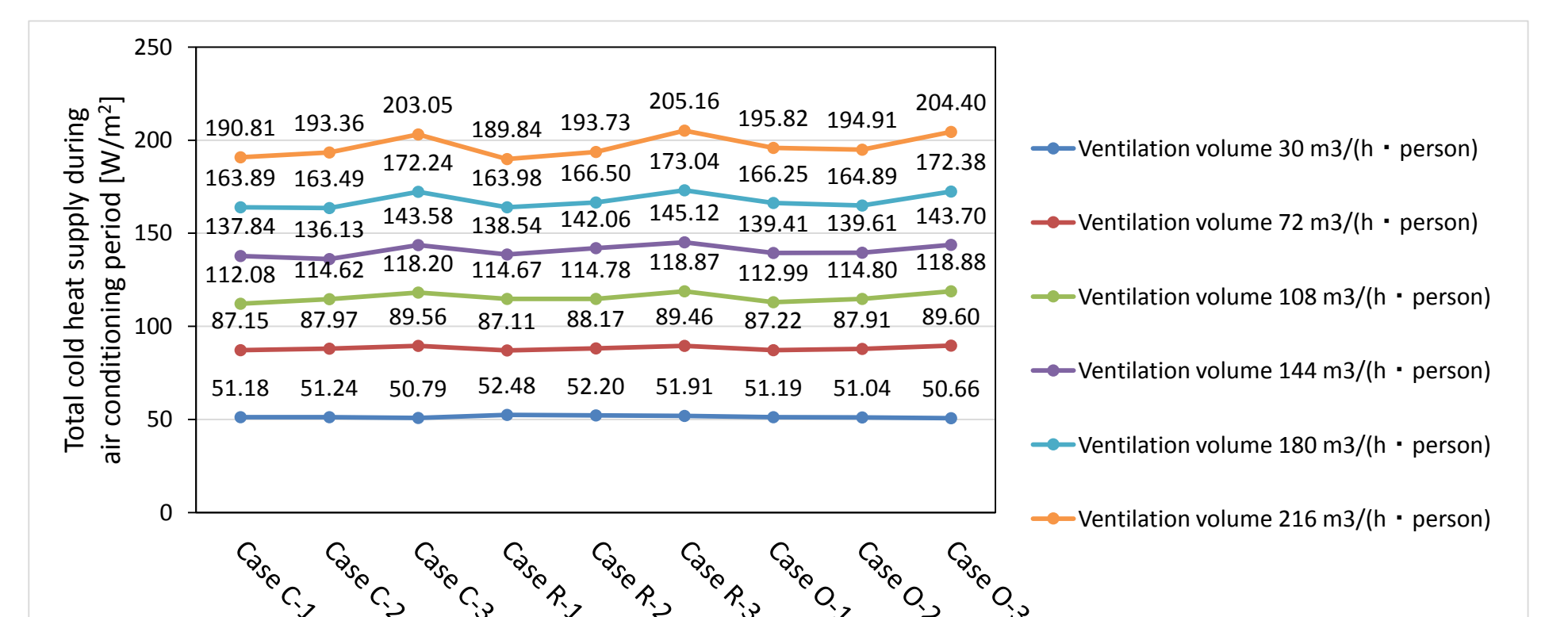
North													
98.87	99.40	99.37	99.20	99.20	99.40	99.40	99.23	99.20	99.37	99.24	99.16	99.20	99.37
99.31	99.28	99.38	99.20	99.06	99.40	99.34	99.02	99.11	99.40	99.45	98.97	99.02	99.37
99.48	99.20	99.31	99.31	99.48	99.40	99.27	99.40	99.34	99.20	99.27	99.40	99.43	98.87
South													
99.11	99.43	99.51	99.27	99.31	99.34	99.48	99.27	99.31	99.43	99.38	99.23	99.23	99.34
99.45	98.97	99.11	99.40	99.48	98.92	99.06	99.28	99.45	98.97	99.27	99.28	99.31	99.12
99.37	99.16	99.27	99.24	99.20	99.16	99.20	99.34	99.40	99.16	99.20	99.34	99.40	98.83

Each square block represents an occupant and his/her position in the room

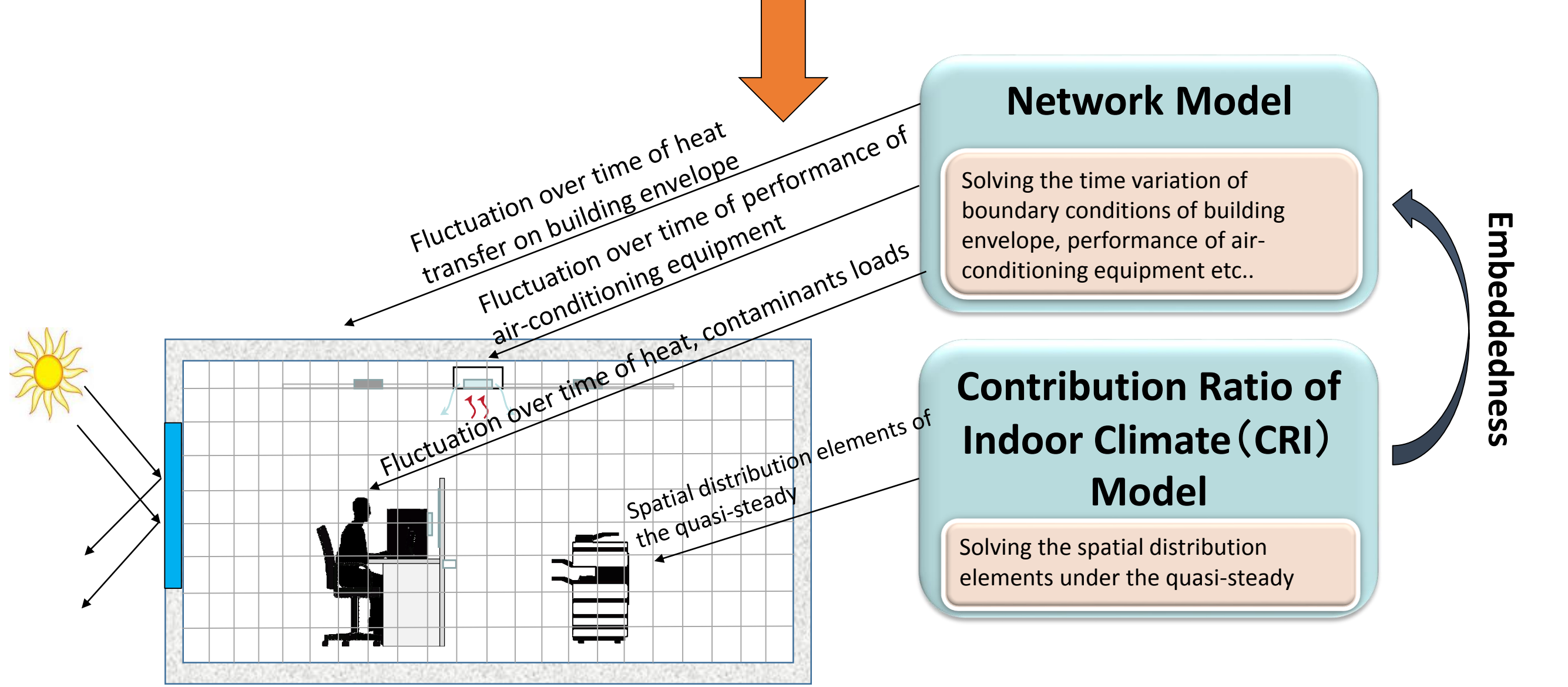
% of dissatisfaction not exceed 50% of each occupant over cooling period

North													
68.74	62.49	61.94	77.39	76.84	63.58	64.02	77.95	77.39	61.80	54.96	76.84	77.21	62.60
79.62	56.16	58.96	76.47	73.08	62.46	57.66	71.17	73.55	62.63	63.74	69.74	71.65	61.66
66.38	76.28	79.39	55.49	64.30	62.35	77.39	62.07	57.66	76.28	78.32	62.35	63.05	68.55
South													
74.27	61.24	63.99	77.21	79.25	54.16	62.77	76.99	79.25	61.24	57.82	77.39	78.69	59.99
65.69	69.51	72.60	61.77	63.44	68.55	71.65	53.49	63.60	69.74	79.02	54.32	55.82	76.10
63.58	76.10	78.32	52.32	76.84	75.36	76.47	59.30	63.05	74.99	76.47	59.85	63.05	67.84

Each square block represents an occupant and his/her position in the room



The ZEB Criterion Office Model with Liquid Cooling Air-conditioning System



Disassembly of Overall View Simulation

Liquid cooling air conditioning system is one of the dedicated outdoor air conditioning system (DOAS system), which aims at further energy saving while maintaining and improving the comfort of room space. By this system, the generated heat loads are dealt with at happening points before being transported into office space. Then a homogeneous thermal environment throughout the residential area can be realized.

