K-027

A study of the planning-support using the floor-plan-database

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1. Computer-Aided-Architectural-Design

1-1. Numerical input system

Today's CAAD (Computer-Aided-Architectural-Design) system is mainly used for fair copy and the presentation of a drawing. And, placement of the rooms is determined by a numerical input and mouse click in Today's CAAD system. This is supposed because the prototype of a floor-plan is already drawn into a user's mind. It can be said that user is performing the design of a floor-plan. Since the user performed the design of a floor plan, it can be said that today's CAAD system does not fit creation of a floor-plan.

1-2. Room-direction input system

In this paper, we propose the CAAD system that outputs a floor-plan from some input of room direction. We have studied floor-planning support by the simple input until today [Reference 1~4]. However, in the previous research, the system might output the unsuitable-floor-plan. For-example, there was a problem in "Connection of rooms", "Balance of room-width and room-depth", "Size of room", etc. In this paper, we solve these problems and propose the CAAD system that outputs a more suitable-floor-plan depending to some room input of direction.

1-3. Planning-support using the floor-plan-database

We introduce floor-plan-database, in order to solve problems mentioned above. In the floor-plan-database, room-placement and room-connection of the existing-floor-plan are stored up. Room-placement and room-connection are converted into the diagram called "minimum-block-plan", and are stored to the floor-plan-database. The system works such that the user inputs some main-room-directions then the system selects minimum-block-plan that is in agreement with the input. And, the system places rooms based on the selected minimum-block-plan.

We describe floor-plan-database in chapter2. And we describe evaluation of the planning-support using the floor-plan-database in chapter3. Finally, we describe conclusion and future-work in chapter4.

2. Architectural-floor-plan-database

2-1. Existing-floor-plan to the minimum-block-plan

The outline of the planning-support using the floor-plan-database is as Fig.1. Chapter 2 is described by dividing into two stages, a database-stage and an application-stage. In the database-stage, first, we input room-directions and room-connections from existing-floor-plans. The method of input places each room of the existing-floor-plan on the grid of 9×9 as shown in Fig.2. The place for each room on the grid is decided from the direction of each room. Next, connection of the rooms on the existing-floor-plan is input. And an unnecessary grid is

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deleted. Moreover, the area of the room is extended so that connection of the input rooms may be filled.
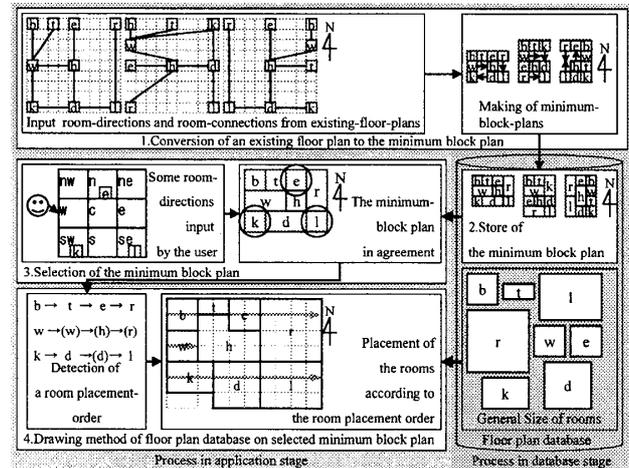
Figure 1: Outline of the planning-support using the floor-plan-database
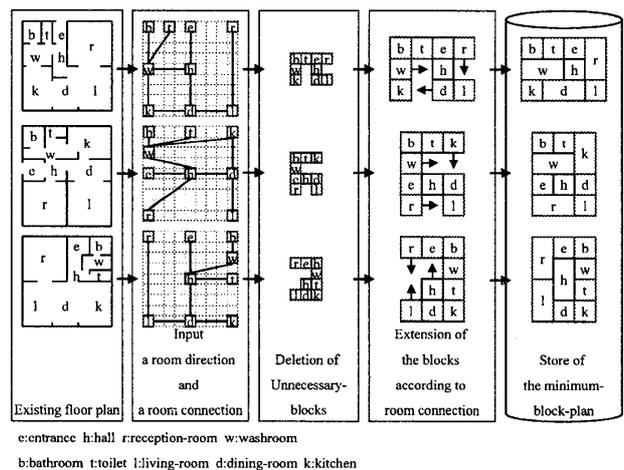

e:entrance h:hall r:reception-room w:washroom
b:bathroom t:toilet l:living-room d:dining-room k:kitchen

Figure 2: Conversion of an existing-floor-plan to the minimum-block-plan

2-2. Store of the minimum-block-plan

Next, the minimum-block-plan made in 2-1 is stored to the floor-plan-database. When storing the minimum-block-plan in a computer, each room on the minimum-block-plan is divided by each room-direction. This is shown in the figure on the right-hand side of Fig.3.

2-3. Selection of the minimum-block-plan

In the application-stage, a user inputs some room-directions. For-example, in the figure at the upper left of Fig.3, the entrance is input to the north (n), kitchen is input to the south-west (s.w.) and living-room is input to the south-east (s.e.). Next, a computer performs comparison with the room-direction input by the user

and the room-direction on the minimum-block-plan group (Center column of Fig.3). The minimum-block-plan selected in Fig.3 is the minimum-block-plan of the upper row.
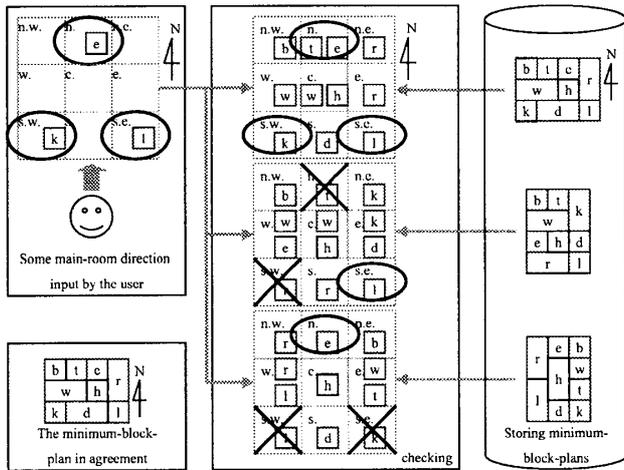

Figure 3: Selection of the minimum-block-plan

2-4. Drawing method of floor-plan based on selected minimum-block-plan

A room placement order is detected from the minimum-block-plan chosen in 2-3. Moreover, as each room-size we use the general-size according to the building size. The size of these general-rooms was taken from reference [Reference 5](upper figure in Fig.4). And the rectangle-room with room-size is placed according to a room-placement-order (lower Fig.4).
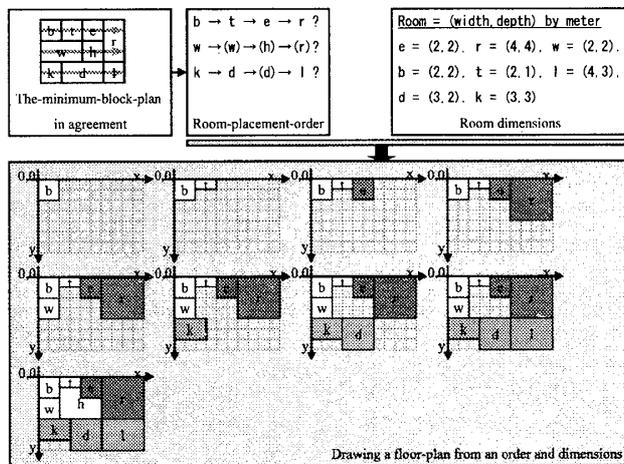

Figure 4: Drawing method of floor-plan based on selected-minimum-block-plan

3. Evaluation of the planning-support using the floor-plan-database
3-1. Method of evaluation

Next, we evaluate the planning-support using the floor-plan-database. First, the method of evaluation inputs the room-direction and the room connection on the existing-floor-plan from reference[Reference 6], and creates the minimum-block-plan. And it observes whether each room-direction and room-connection on the existing-floor-plan is expressed by the minimum-block-plan. Second, we create the floor-plan which

had a size from the minimum-block-plan. And it observes whether each room-direction and room-connection on the existing-floor-plan are expressed by the created floor-plan. We followed 12 floor-plans which consist of 9 rooms in the above observation, Moreover, and 5 floor-plans which consist of 10 rooms, in order to observe results when there are more rooms. Fig.5 shows 12 floor-plans which consist of 9 rooms to left-side. And, 5 floor-plans which consist of 10 rooms are shown in right side.

3-2. Expression of the minimum-block-plan

First, we observe whether the minimum-block-plan can be made from the input of each room-direction and room-connection on the existing-floor-plan. By the floor plan which consists of 9 rooms, the room direction (from 09-01-xxx-x to 09-12-xxx-x) , are given [Fig.5]. Then, the room-connection (from 19-01-A01-x) to (09-12-A12-x) are given. The minimum-block-plan (from 09-01-A01-S to 09-12-A12-S) is output from these inputs. Although each room-directions of all the minimum-block-plan are filled, filling room-connection is 7 examples which have ○mark in the lower right, such as (09-01-A01-S). Second, 5 floor-plans which consist of 10 rooms are observed. Each room-direction (from 10-01-xxx-x to 10-05-xxx-x) and room-connection (from 10-01-B01-x to 10-05-B05-x) on the existing-floor-plans is input. And the minimum-block-plan (from 10-01-B01-S to 10-05-B05-S) are output from these inputs. Consequently, the minimum-block-plan which fills room-connection was 5 examples which have ○mark in the lower right, such as (10-01-B01-S).

3-3. Expression of the floor-plan

The system decides general room-size to the minimum-block-plan gained by 3-2, and makes each floor-plan as output. In the case of 9 rooms, 12 floor-plans (from 09-01-A01-P to 09-12-A12-P) were output. Filling room-connection in these was 3 examples which have ○mark in the lower right, such as (09-03-A03-P). Moreover, in the case of 10 rooms, 5 floor-plans (from 10-01-B01-P to 10-05-B05-P) were output. Filling room-connection in these was 4 examples which have ○mark in the lower right, such as (10-01-B01-P).

3-4. Application of an appearance frequency

Then, we find out general-purpose-room-connection, in order to raise the rate of room-connection. We describe the making method of general-purpose-room-connection. In the case of 9 rooms, from 12 room-connections (from 09-01-A01-x to 09-12-A12-x), frequency of appearance extracts 7 or more room-connection, and newly creates the room-connection (A00) [Left side of Fig.6]. Application of this new-room-connection (A00) outputs the minimum-block-plan from (09-01-A00-S to 09-12-A00-S). The minimum-block-plan which fills the new general-purpose-room-connection (A00) in these minimum-block-plans was 10 examples which have O mark in the lower right, such as (09-01-A00-S). And, 12 floor-plans (from 09-01-A00-P to 09-12-A00-P) were drawn up using the room-connection (A00). The floor-plan which filled room-connection in these 12 floor-plans was 9 examples which have O mark in the lower right, such as (09-01-A00-P) [Fig.5]. In the case of 10 rooms, from 5 room-connections (from 10-01-B01-x to 10-05-B05-x), frequency of

9 rooms floor-plan
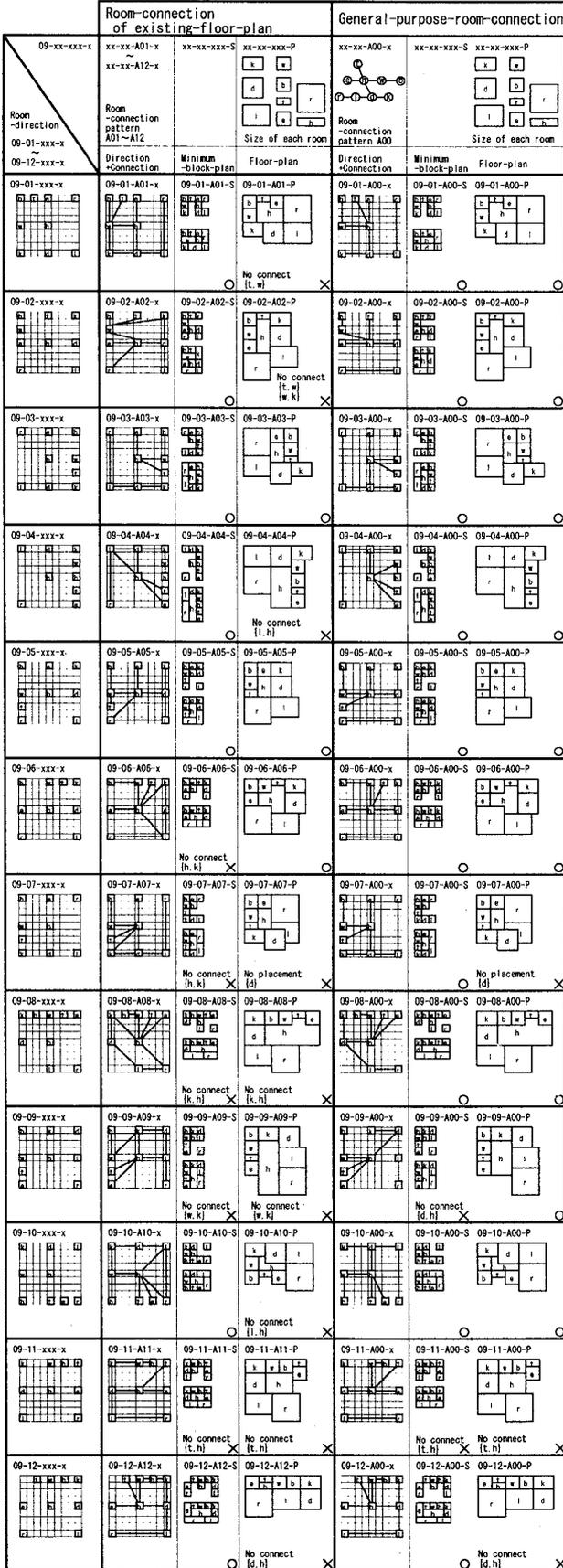
10 rooms floor-plan
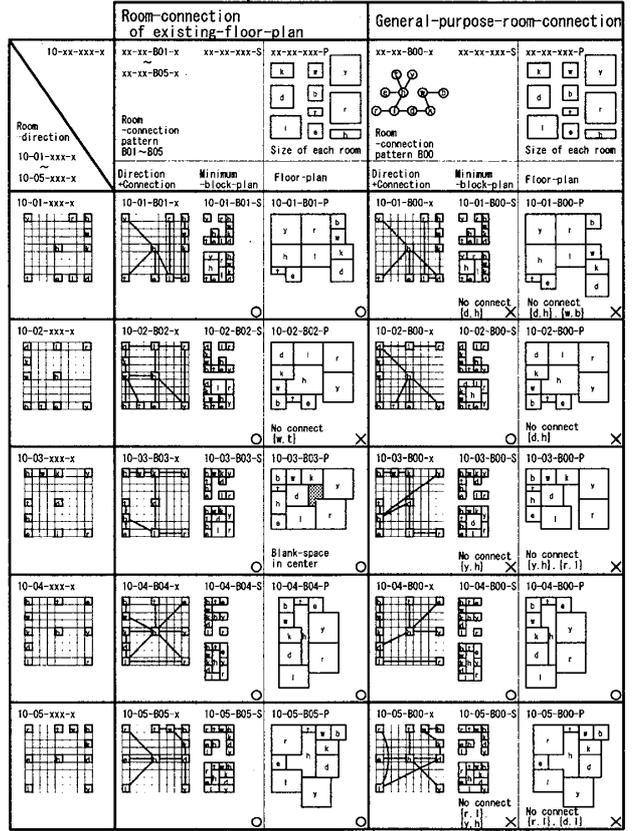
Plan number(ww-xx-yyy-z)

ww : Number of rooms
xx : Number of room-direction pattern
yyy : Number of room-connection pattern
z : Type of plan
  (S: Minimum-block-plan, P: Floor-plan)

Room-initial: Room name(width×depth)㎡

e : entrance   (2×2)㎡
h : hall   (no limit)
r : reception-room   (4×4)㎡
w : washroom   (2×2)㎡
b : bathroom   (2×2)㎡
t : toilet   (2×1)㎡
l : living-room   (4×3)㎡
d : dining-room   (3×3)㎡
k : kitchen   (3×2)㎡

10-rooms case only

y : western-style-room (4×4)㎡

Figure 5: Result of the minimum-block-plan and the floor-plan

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appearance extracts 3 or more room-connection, and newly creates the room-connection (B00) [Right side of Fig.6]. Application of this new-room-connection (B00) outputs the minimum-block-plan (from 10-01-B00-S to 10-05-B00-S). The minimum-block-plan which fills the new general-purpose-room-connection (B00) in these minimum-block-plans was 2 examples which have O mark in the lower right, such as (10-02-B00-S). And, 5 floor-plans (from 10-01-B00-P to 10-05-B00-P) were drawn up using the room-connection (B00). The floor-plan which filled room-connection in these 5 floor-plans was only 1 example which have O mark in the lower right, such as (10-04-B00-P) [Fig.5].

3-5. Result of application

As results we describe the tendency of the room-connection when drawing up the minimum-block-plan and a floor-plan using general-purpose-room-connection.

First, the floor-plan which consists of 9 rooms is described. When room-connection of the existing floor-plan is used, the rate of achievement of the room connection by the minimum-block-plan is 7/12. And, by the floor-plan, that is 3/12 of the rates of achievement. On the other hand, when the general-purpose-room-connection (A00) is used, the rate of achievement of the room-connection in the minimum-block-plan is 10/12. And by the floor-plan, that is 9/12 of the rates of achievement.

Second, the floor-plan which consists of 10 rooms is described. When room-connection of the existing floor-plan is used, the rate of achievement of the room—connection by the minimum-block-plan is 5/5. And, by the floor-plan, that is 4/5 of the rates of achievement. On the other hand, when the general-purpose-room-connection B00 is used, the rate of achievement of the room-connection in the minimum-block-plan is 2/5. And by the floor-plan, that is 1/5 of the rates of achievement [Fig.7].

Although general-purpose room connection is effective for the floor plan of 9 rooms, it is not effective for the floor-plan of ten rooms. This means, when one room is increased, it turns out that room-connection is varied.

3-6. Efficiency of the minimum-block-plan

Accordingly, if the number of rooms increases, it will be hard to create general-purpose-room-connection. Therefore, it is effective to create the minimum-block-plan of a room-direction and room-connection in the existing-floor-plan, and to newly draw up a floor-plan using these minimum-block-plan.

4. Conclusion

In this paper, we proposed the system that creates the sketch used in the stage before input a drawing into the conventional CAAD system. The sketch (Floor-plan) is created in a user input some room-directions. In order to draw up a floor-plan from such inputs, we introduced the floor-plan-database. Multiple minimum-block-plans are stored in the floor-plan-database, and the minimum-block-plan that agrees with a user's is selected. And the selected minimum-block-plan is used as a base, and a floor-plan is drawn up. In order to show the efficiency of this method, we used the minimum-block-plan and drew up some floor-plans. When a floor-plan with more rooms is drawn up

from a result, the necessity for minimum-block-plan of many existing design examples became clear.
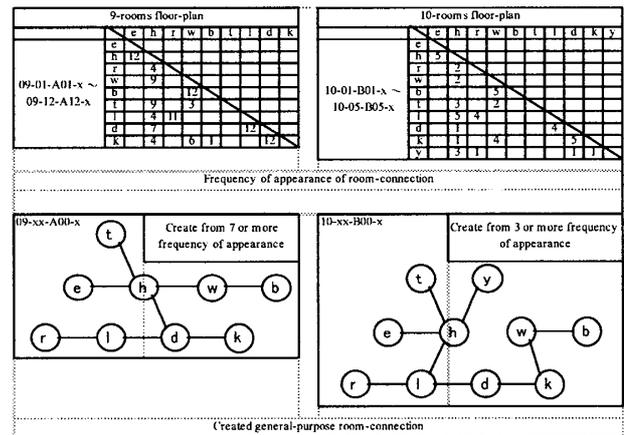

Figure 6: General-purpose-room-connection

Figure 7: Relation of the minimum-block-plan and the floor-plan

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