QAP Reformulation

- **Without road capacity**
  - **Input**

In the reformulation of QAP, we introduce virtual node 100 as government except buildings and candidate locations as shown in Fig.1. We also add two residential developers and two commercial developers. Agent 5 and 6 represent residential developer of home building 101 and 102 respectively. Agent 7 and 8 represent commercial developer of office building 401 and 402 respectively. Residential developer can go along with building-to-location arc and planning arc. The origin of residential developer of home building is home building, the destination is government. The origin of commercial developer of office building is government, the destination is office building. Of course, the traveler's origin and destination are also home building and office building. Traveler can go on building-to-location arc and physical link. In this example, we assume the cost on building-to-location arc and planning arc is equal to zero. Therefore, we just only consider transportation cost of traveler. For agent of traveler type, an agent represents all travelers between one home building and one office building. For example, the origin of traveler 3 and 4 is both home building 102, their destination is both office building 401. So, we regard traveler 3 and 4 as one agent. According to the rule, we signed all travelers again. We mark traveler 1 as agent 1, traveler 2 as agent 2, traveler 3 and 4 as agent 3 and traveler 5 as agent 4 as shown in 1. The traffic flow matrix between any two buildings of different type is

$$\begin{array}{lc} & \text{Office building } j \\ & \begin{array}{cc} 401 & 402 \end{array} \\ \text{Home builidng } i \quad \begin{array}{c} 101 \\ 102 \end{array} & \begin{bmatrix} 1 & 1 \\ 2 & 1 \end{bmatrix} = [f_{ij}] \end{array}$$

The value on physical link is transportation cost of unit flow. The transportation cost matrix of per unit traffic flow between any two locations of different type is

$$\begin{array}{lc} & \text{Locations for office buildings} \\ & \begin{array}{cc} 301 & 302 \end{array} \\ \text{Locations for home buildings} \quad \begin{array}{c} 201 \\ 202 \end{array} & \begin{bmatrix} 6 & 7 \\ 7 & 5 \end{bmatrix} = [c_{kl}] \end{array} .$$

The possible transportation cost between locations for each traveler agent $c_{uv}(a)$ is equal to $f_{ij} \times [c_{kl}]$. For agent 1, 2, 3 and 4, the cost matrix is

$$\begin{array}{c} \\ 201 \\ 202 \end{array} \begin{array}{c} \begin{array}{cc} 301 & 302 \end{array} \\ \begin{bmatrix} 7 & 6 \\ 6 & 5 \end{bmatrix} \end{array} , \begin{array}{c} \\ 201 \\ 202 \end{array} \begin{array}{c} \begin{array}{cc} 301 & 302 \end{array} \\ \begin{bmatrix} 7 & 6 \\ 6 & 5 \end{bmatrix} \end{array} , \begin{array}{c} \\ 201 \\ 202 \end{array} \begin{array}{c} \begin{array}{cc} 301 & 302 \end{array} \\ \begin{bmatrix} 14 & 12 \\ 12 & 10 \end{bmatrix} \end{array} \text{ and } \begin{array}{c} \\ 201 \\ 202 \end{array} \begin{array}{c} \begin{array}{cc} 301 & 302 \end{array} \\ \begin{bmatrix} 7 & 6 \\ 6 & 5 \end{bmatrix} \end{array} ,$$

respectively.

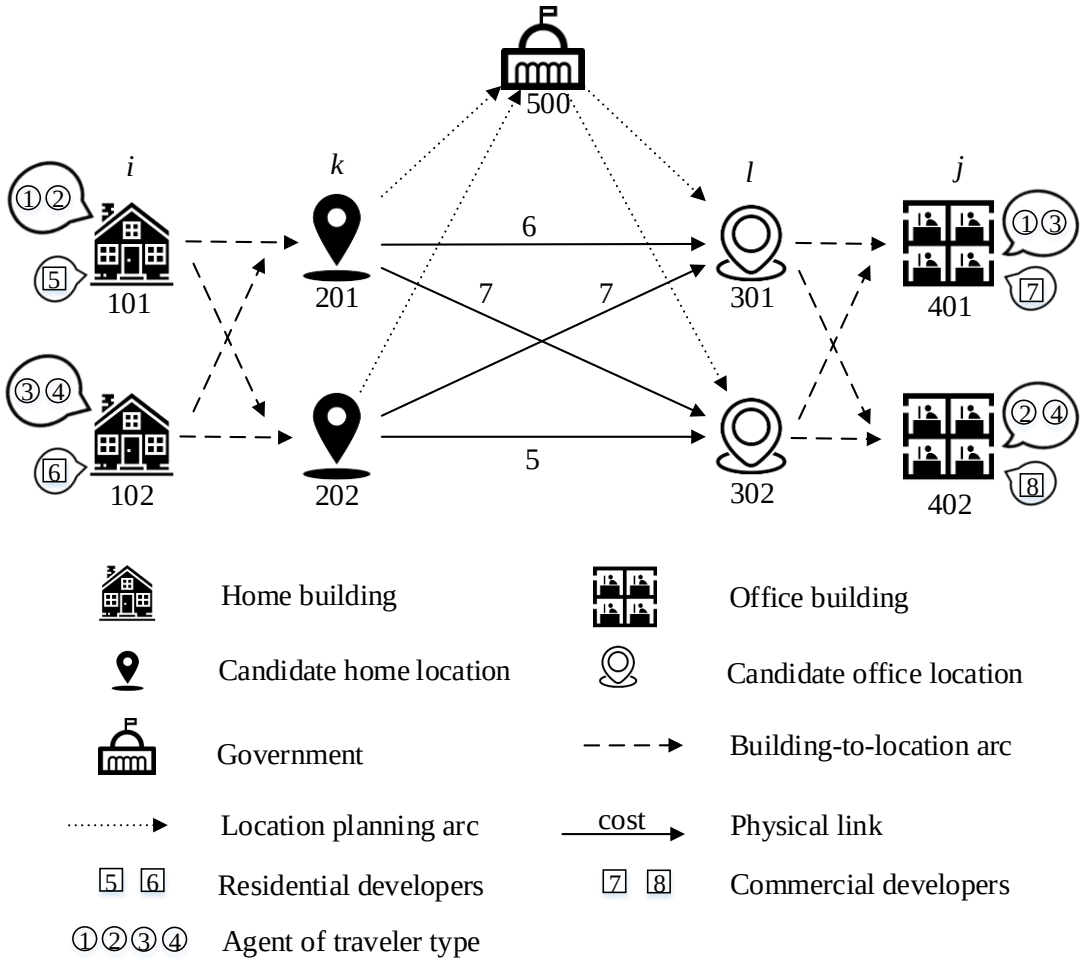

Fig. 1. Illustrative example of reformulation QAP without road capacity

■ Output

Table 1 shows the solution by ADMM. There is no optimal solution. The solution by ADMM is not satisfied with constraints of the model.

Table 1
The solution of the illustrative example without road capacity.

u	*v*	Agent
101	201	1
101	202	2
101	202	5
102	201	3
102	201	4
102	201	6
201	301	4
201	302	1
201	302	3
201	500	6

202	301	2
202	500	5
301	402	2
301	402	4
301	402	8
302	401	1
302	401	3
302	401	7
500	301	8
500	302	7