



Connection Planning for Public Transit Hub

Connections between different transport modes influence substantially the overall transportation efficiency and people's experience in travel convenience. H city is going to build a public transit hub connecting 5 modes of transport. Your consulting team is asked by your client, the construction company of the hub project, to provide a solution for the connection layout planning. The basic conditions and information you have obtained in advance are as follows:

- (1) The available area for each floor of the hub is 10,000 square meters with length of 100 meters and width of 100 meters;
- (2) The functional region corresponding to a transport mode cannot be overlapped with one another when such functional regions are exchanged on the same floor;
- (3) The exchange volumes between transport modes are shown in Table 1;
- (4) The functional region for a transport mode can be simplified as rectangle, the required area and measurement are shown in Table 2;
- (5) The construction cost of a functional region/station differs if the same region/station is built on a different floor, see Table 3;
- (6) The vertical distance between two floors is about 15 meters.

Your team is required to give a solution by mathematical modeling to determine how many floors for the transit hub to build, on which floor and where on the determined floor to arrange for each functional region so as to do best in saving the total construction cost and shortening passengers' exchange distance as well.

Your submission should include a 1-page Summary Sheet and your solution cannot exceed 20 pages for a maximum of 21 pages. The appendices and references should appear at the end of the paper and do not count towards the 20 pages limit.

Table 1. Exchange Volume between Transport Modes

Number of Passengers/Hour	Walking	High Speed Train	Bus	Taxi	Light Railway
Walking	0	600	500	200	1500
High Speed Train	600	0	1300	1000	3000
Bus	500	1300	0	100	800
Taxi	200	1000	100	0	200
Light Railway	1500	3000	800	200	0
Total	2800	5900	2700	1500	5500



Table 2. Functional Region Measurements for Different Transport Modes

	Walking Area	High Speed Train Station	Bus Terminus	Taxi Area	Light Railway Station
Area Required (m ²)	2500	5000	2500	1000	4000
Length	50	100	50	50	80
Width	50	50	50	20	50

Table 3. Construction Costs for Functional Regions at Different Floors (RMB Yuan/m²)

	Walking Area	High Speed Train Station	Bus Terminus	Taxi Area	Light Railway Station
3 rd Floor	1600	2600	2600	2600	2600
2 nd Floor	1200	2200	2200	2200	2200
1 st Floor	1000	2000	2000	2000	2000
Ground Floor	800	1600	1600	1600	1600
-1 st Floor	3000	3000	3000	3000	3000
-2 nd Floor	3600	3600	3600	3600	3600
-3 rd Floor	4400	4400	4400	4400	4400