

SPATIAL MATERIAL STOCK ANALYSIS OF SHENYANG CITY IN CHINA USING 4D-GIS

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Introduction

With the rapid development of Chinese urbanization, a large amount of material has been consumed for the construction and maintenance of infrastructure, which has also caused severe environmental impacts. Shenyang city is a typical old industrial base in China, has been reconstructed and relocated for more than 100 years. As shown in Fig.1, the total investment on buildings and transport facilities has been booming for the last decades. A number of studies have been conducted on material stock analysis in China. However, most of them analyze the material stock of the whole China by statistical data neglecting statistical distribution characteristics and material intensity's regional differences of infrastructures. This study will take 10km² area of Tiexi district in Shenyang city (Fig. 2) as an example to analyze material stock accumulation by 4d-GIS method. We first make 4d-GIS data from 1978 to 2010 base on the historical maps and statistical data of research area. Secondly, we estimate the accumulation of material stock of infrastructures including buildings and roads and railways and sewer through surveying material intensities and suitable calculation methodologies. Thirdly, we analyze the temporal and spatial evolution of infrastructure material stock. Finally, a certain policy implications are discussed in order to achieve a dematerialization society in Shenyang city.

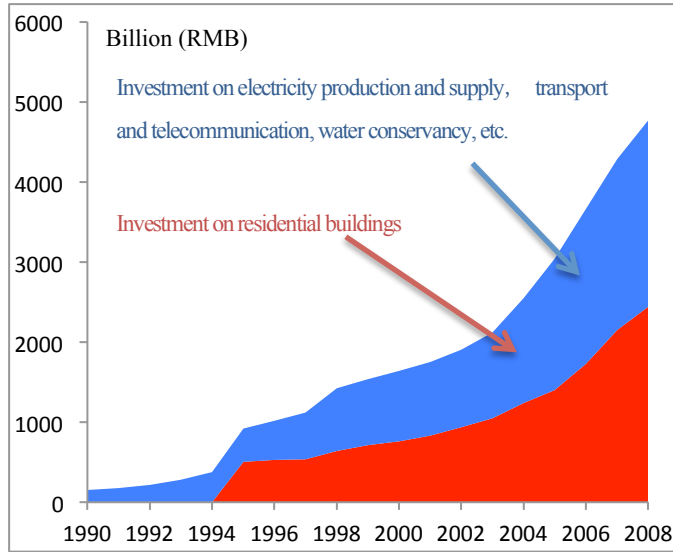


Fig. 1 investment on buildings and infrastructures in China

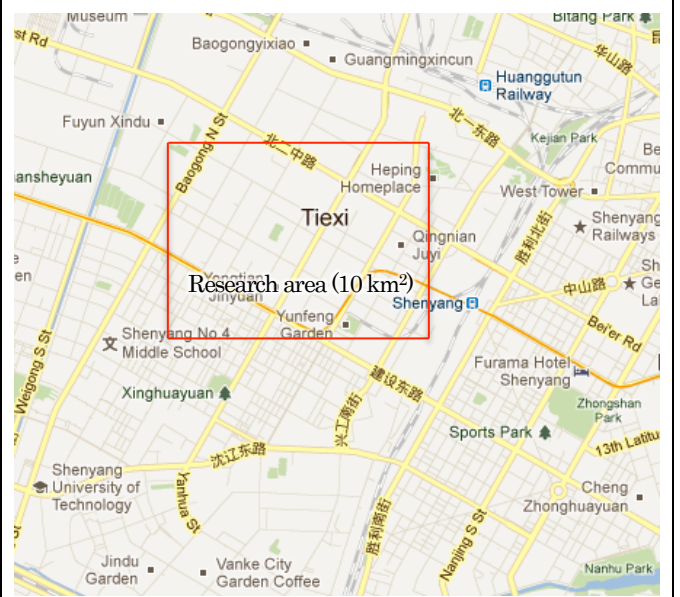


Fig. 2 Research area of 10 km² in Tiexi district, Shenyang city

Methodology

Material stock estimation of research area is based on both 4d-GIS data and statistical data. Fig. 3 shows the methodology of material stock estimation by these two kinds of data sources. Firstly, we extract special information for selected area to establish the spatial information database. In the similar way, we survey the material intensity data classified by structures of infrastructures including building, road, railway as well as sewer, as the result of establishing the statistical data. Secondly, based on the spatial and statistical information database, we can estimate the material stock of surface and sub-surface of these infrastructures through equation (1).

$$MS_{i,m,n}^t = \sum (S_{m,n}^t \times I_{i,m,n}^t) \quad (1)$$

Where $MS_{i,m,n}^t$ is the total amount of material i stocked in structure m , type n in year t ; and $S_{m,n}^t$ is the volume of spatial data of structure m , type n in year t from 4d-GIS data. Spatial data means the amount of physical structures, for example, building floor area, the length of sewer and the area of road. $I_{i,m,n}^t$ indicate the intensity of material i in structure m , type n in year t , which is a kind of indication of distribution of a given material i per

stock in structure m , type n .

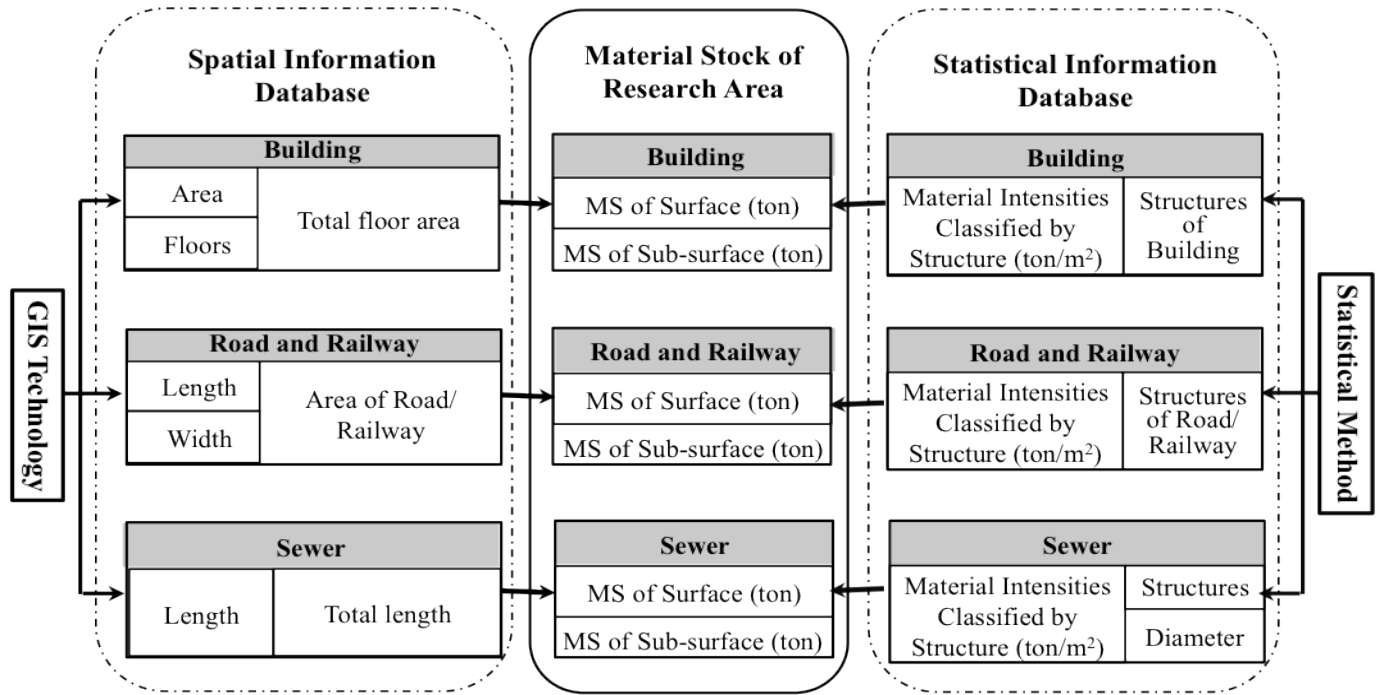


Fig. 3 Methodology of estimation material stock using GIS data

Data

Table 1 Data and material used for calculation

Data Type	Type	Structure	Data Source
Statistical Data	Building	Residential	China Statistical Yearbook on construction
		Industrial	China Statistical Yearbook
		Commercial	Shenyang Statistical Yearbook
	Transport	Railway	China Transport Statistical Yearbook
		Road	Shenyang Statistical Yearbook
	Sewer	Diameter	Liaoning Statistical Yearbook
4d-GIS Data	Surface		Arc GIS data for Tiexi district
	Sub-surface		Urban planning maps of Shenyang city
			Google earth photos of Shenyang city

Results and Discussion

The result of this study will show the stock amounts of different kinds of material contained in infrastructure. We can learn material stock's distribution conditions of research area ranging from 1978 to 2010. The comparison will be taken between Wakayama city in Japan and Shenyang city, as the result of analyzing the their characteristics and differences. Finally, we can know the reason why there exists this kind of disparity phenomenon, so that to provide valuable information for government to achieve a dematerialization society in Shenyang city.

As future study, we will choose Beijing city as research area to estimate its material stock amount in spatial sector by means of 4d-GIS data, and then compare with Shenyang city, Wakayama city and Manchester city's cases. We can further understand differences of the material stock accumulation in different counties accurately.

Reference

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