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RESEARCH ON NATIONAL 1:50000 TOPOGRAPHIC CARTOGRAPHY DATA ORGANIZATION

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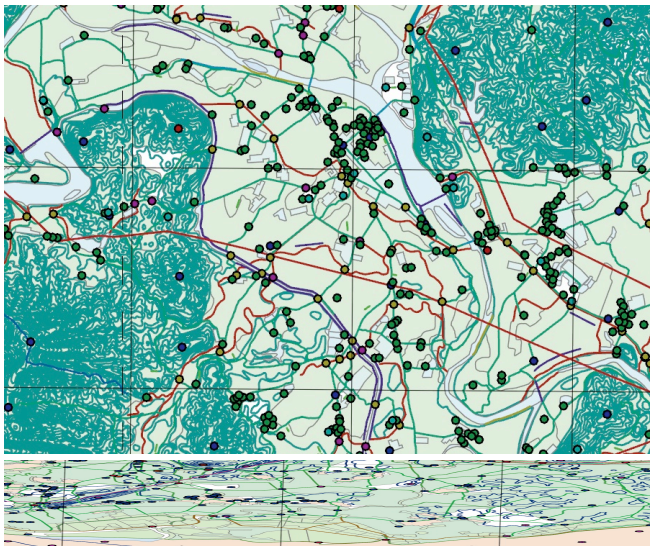
INTRODUCTION

In China, it's the first time to use database-driven cartography technology in national terrain information database, and is more complex used in 1:50000 topographic maps. To use this technology efficiently, it is very necessary to design rational model for data organization and presentation mechanisms.

RESEARCH

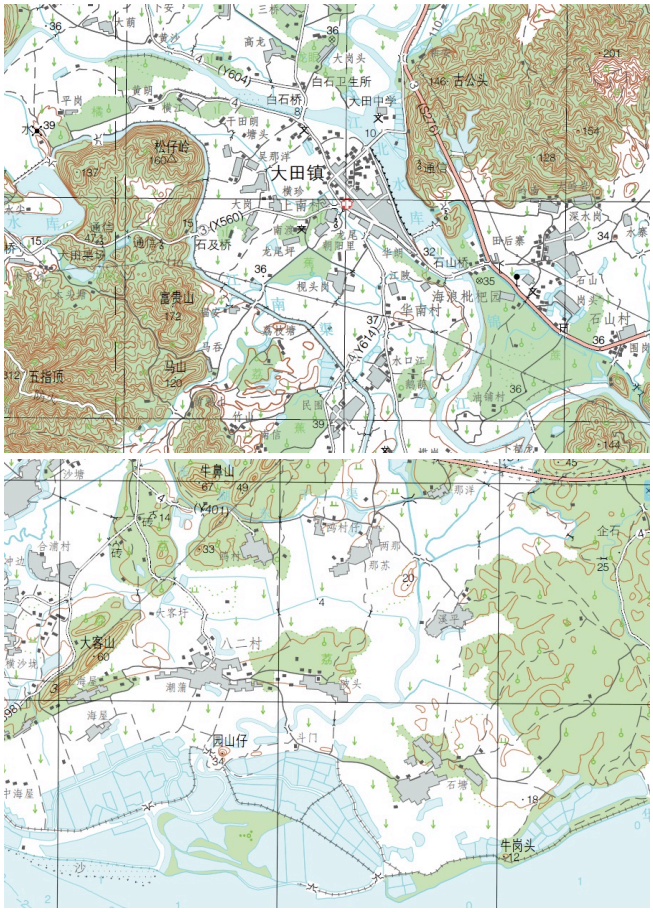
The national database-driven production of 1:50000 topographic maps, is based on the update project of national 1:50000 terrain information database completed recently. The source database is consisting of 9 data sets, 34 layers in different data type, and more than 300 kinds of features. It is stored in Oracle by using ArcSDE.

As shown in Fig.1and 2, simple points, lines and polygons are transformed to a map which gives a lot of information.



(a)(b)

Fig.1 Source terrain data



(a) (b)

Fig.2 Topographic map data

Research work carried out through observation of technical methods used home and abroad. With the actual experience from production unit, comparative analysis and system summary of difference between terrain data status and topographic map data requirements were taken. As a result, the main data organization structure of cartography data is summarized as below.

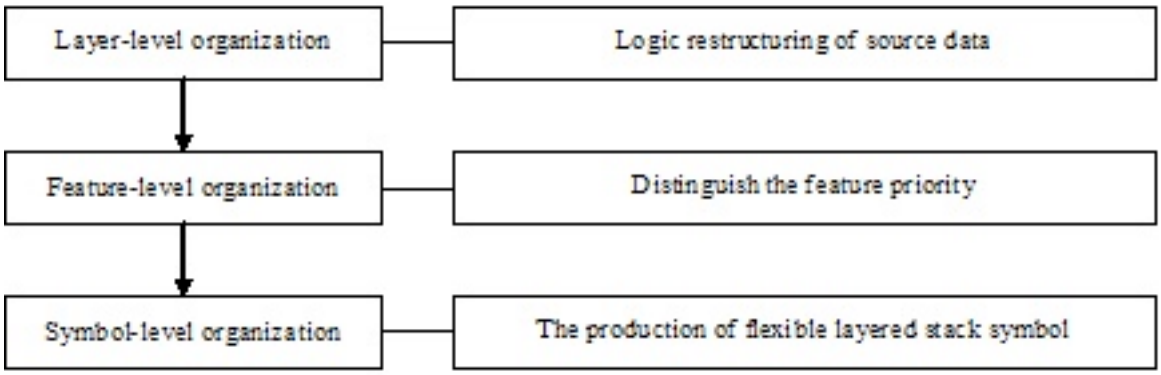


Fig.3 Organization hierarchy structure of cartography data

The layer-level organization

The hierarchical structure and overall framework of cartography data are highly depend on the source database. 34 source feature layers were split, sorted, and grouped. At the same time, certain relationships exist between layers. It allows interruption, cover, topological manipulation between layers, without changing the real data. So it will be easier to get flexible effect.

(1) 4 layer group

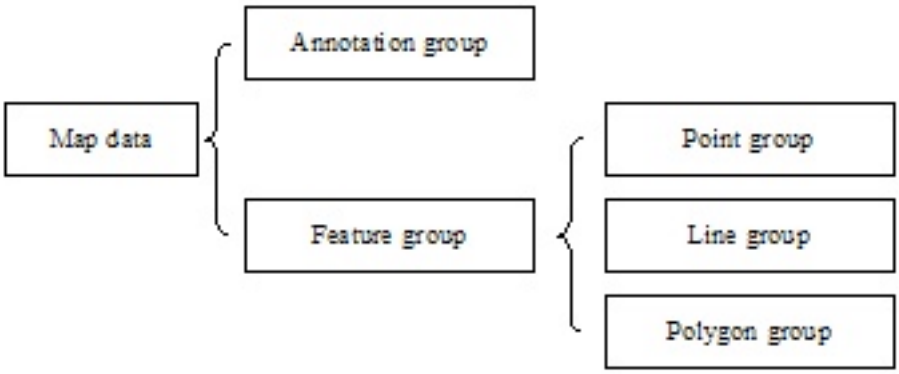


Fig.4 layer group of cartography data

(2) Organization in each layer group

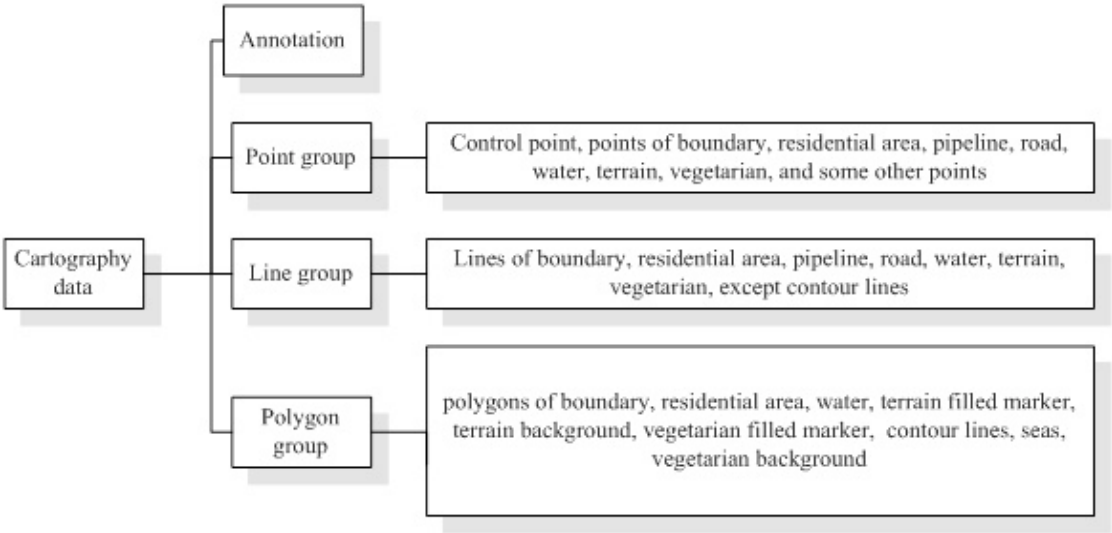


Fig.5 layer organization in each group

The underpass and overpass relationships are reflected by logical organization of these topographic map layers.

(3) The relationship between layers

Layers also have associated physical and cartographic relationships besides logical link. It is mainly reflected in two aspects: derivation and mask.

The feature-level organization

Features in the same layer are also organized in reasonable order.

The feature priority make high way is drawn above any other roads on the topographic map. And symbol integration lets you create effect of roads connectivity.

The symbol-level organization

One symbol can divide to several symbol layers. Each layer can be drawn with one factor in graphics library which is taken as one part of the whole symbol. Then different geometry effect can be set to design a combination symbol, similar to the jigsaw puzzle. So symbols can be simply modified, without re-create the whole symbol.

EXPERIMENT AND APPLICATION

Experiment system is developed on ArcGIS9.3.1.

Fig.6 Experiment system boot screen

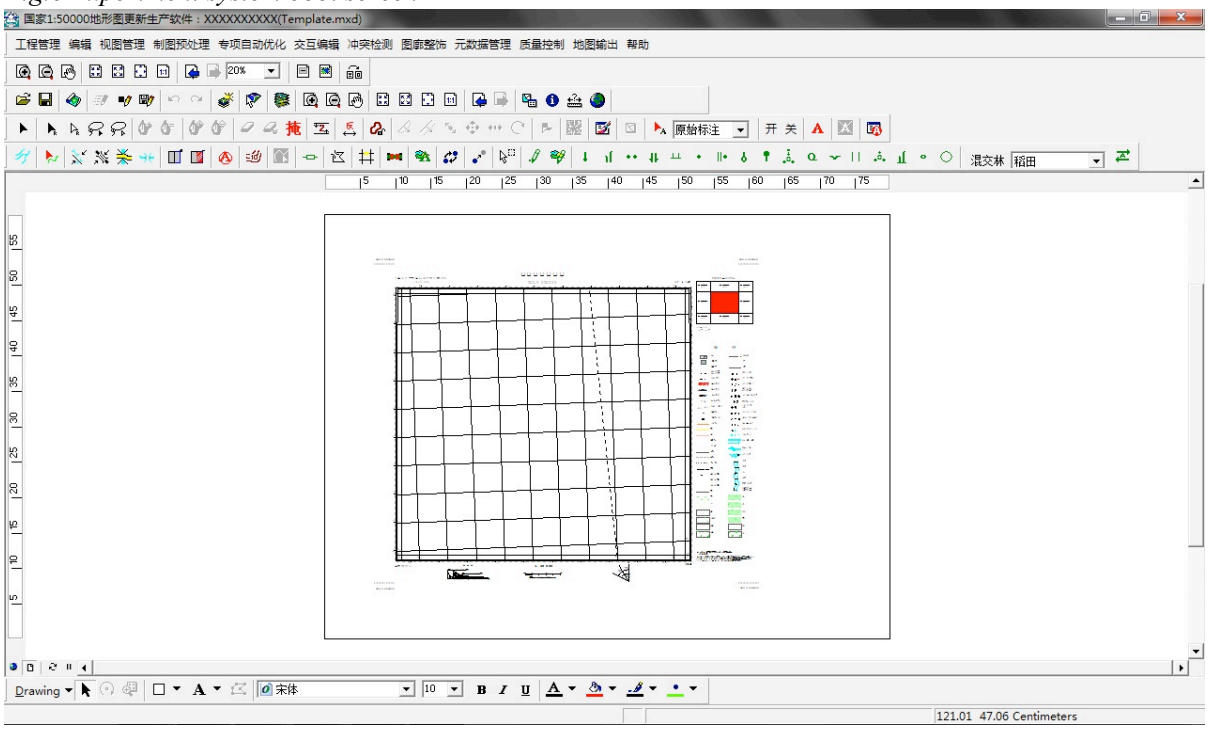


Fig.7 Initial user interface of a cartography project

Fig.8 Experiment system toolbars

Experiment on layer-level

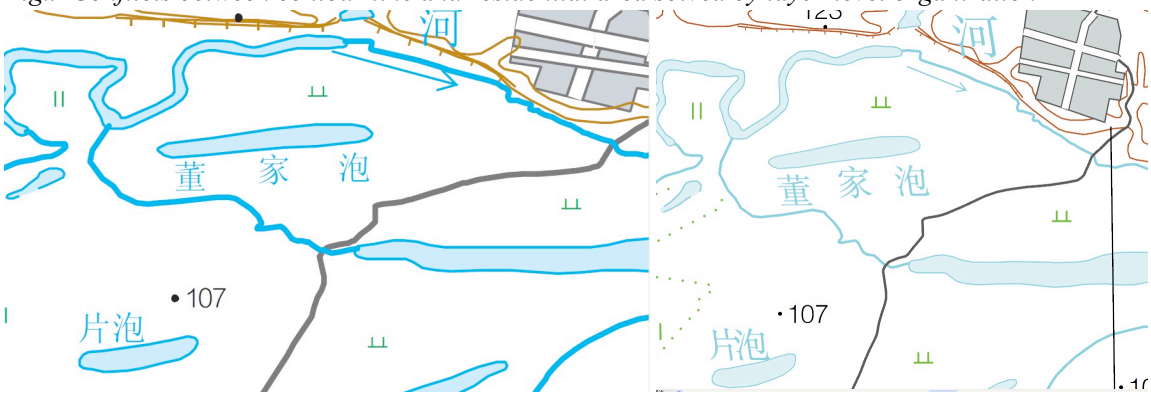
In experiment system, it is stored in project document. When a cartography project is open, the document will auto add data to relative layers.

Fig.9 and Fig.10 shows the layer organization original terrain database and the layer organization of cartography data. In Fig.9(a), contour lines were drawn cross roads and residential areas. And in Fig.10(a),

a river was drawn overpass a road. After reorganized the layers according to the layer-level organization data model, these graphic conflicts have been solved, as shown in Fig.9 (b) and Fig.10(b).

(a) (b)

Fig.9 Conflicts between contour line and residential area solved by layer-level organization

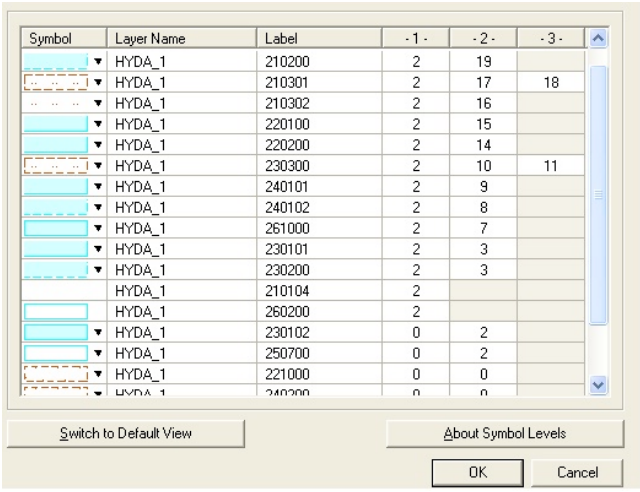


(a) (b)

Fig.10 Conflicts between river and road solved by layer-level organization

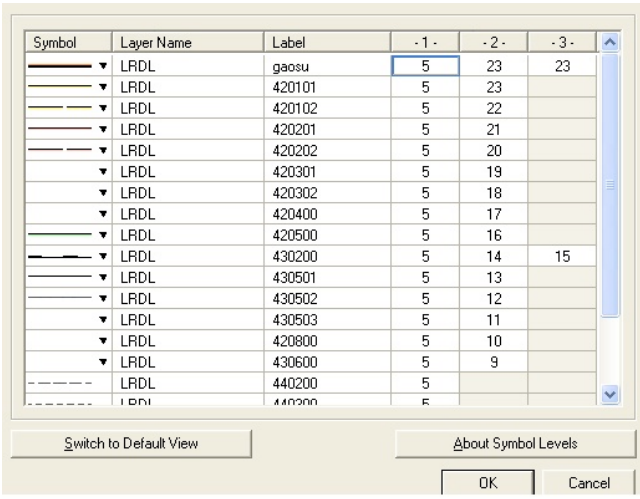
Experiment on feature-level

Like an expert system which stores the features' relationship, feature-level data model is stored in the layer's attribute. As Fig.11 shows, it is a list with feature code, symbol and some numbers on it. The "Label" means the feature's name, while the last three columns denote different kinds of feature priority and symbol integration.



Symbol	Layer Name	Label	- 1 -	- 2 -	- 3 -
	HYDA_1	210200	2	19	
	HYDA_1	210301	2	17	18
	HYDA_1	210302	2	16	
	HYDA_1	220100	2	15	
	HYDA_1	220200	2	14	
	HYDA_1	230300	2	10	11
	HYDA_1	240101	2	9	
	HYDA_1	240102	2	8	
	HYDA_1	261000	2	7	
	HYDA_1	230101	2	3	
	HYDA_1	230200	2	3	
	HYDA_1	210104	2		
	HYDA_1	260200	2		
	HYDA_1	230102	0	2	
	HYDA_1	250700	0	2	
	HYDA_1	221000	0	0	

Switch to Default View | About Symbol Levels | OK | Cancel



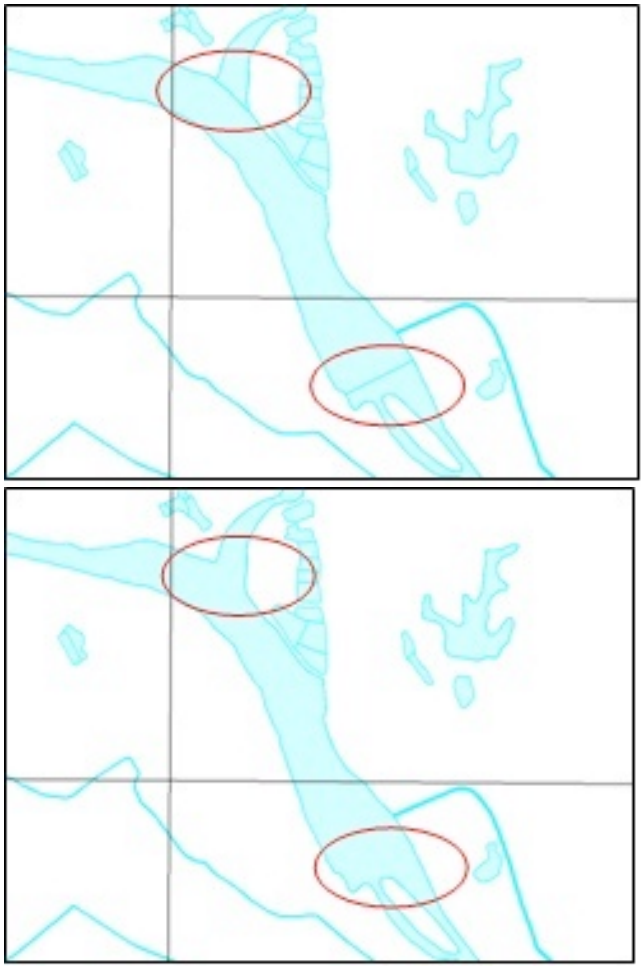
Symbol	Layer Name	Label	- 1 -	- 2 -	- 3 -
	LRDL	gaosu	5	23	23
	LRDL	420101	5	23	
	LRDL	420102	5	22	
	LRDL	420201	5	21	
	LRDL	420202	5	20	
	LRDL	420301	5	19	
	LRDL	420302	5	18	
	LRDL	420400	5	17	
	LRDL	420500	5	16	
	LRDL	430200	5	14	15
	LRDL	430501	5	13	
	LRDL	430502	5	12	
	LRDL	430503	5	11	
	LRDL	420800	5	10	
	LRDL	430600	5	9	
	LRDL	440200	5		

Switch to Default View | About Symbol Levels | OK | Cancel

(a) water area layer (b) road layer

Fig.11 feature-level organization data model of layers

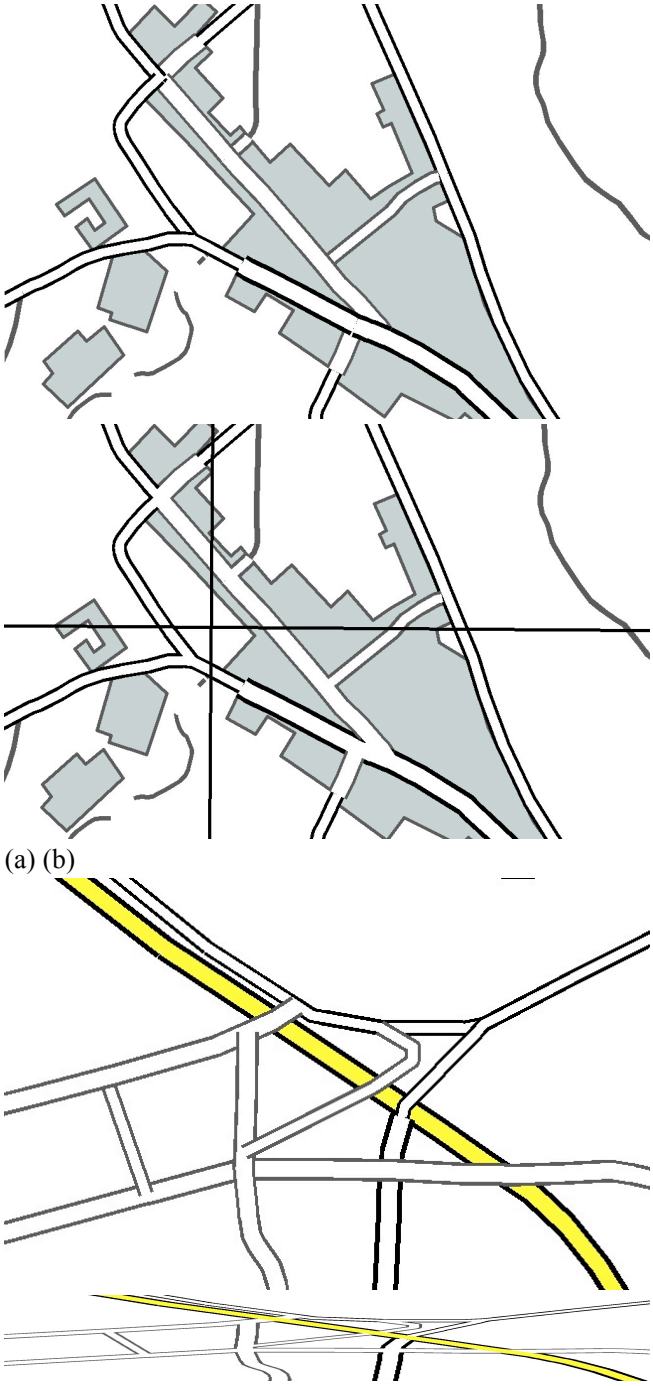
As shown in Fig.12, rivers consist of different polygons merge at intersect. After the integration the edge shared by neighbor polygons disappeared.



(a) Before integration (b) After integration

Fig.12 Feature-level organization in water area layer

Fig.13 (a) and (b) are the contrast before and symbol integration, (c) and (d) add set of feature priority to the contrast of symbol integration. The yellow road has higher priority than other roads, so it was drawn overpass others. And all intersects of roads have been merged by symbol integration to realize the connectivity of roads.



(a) (b)

(c) (d)

Fig.13 Feature-level organization in road layer

Experiment on symbol-level

As shown in Fig.14 (a), in most graphic software, to realize a wire net symbol, it needs to copy symbol“+” many times. In experiment system, factor “+” only edited one time and set a step length in one symbol layer. It will auto drawn many times in certain pattern along the line(Fig.14(b)).

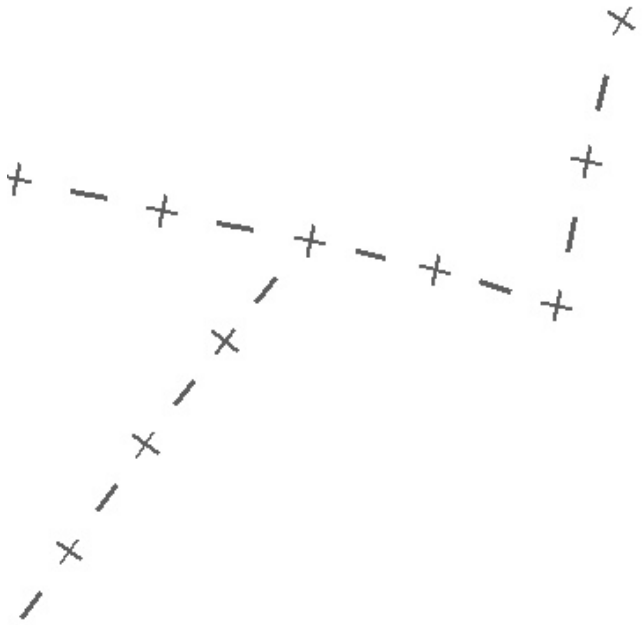


Fig.14 (a) Symbol of wire net

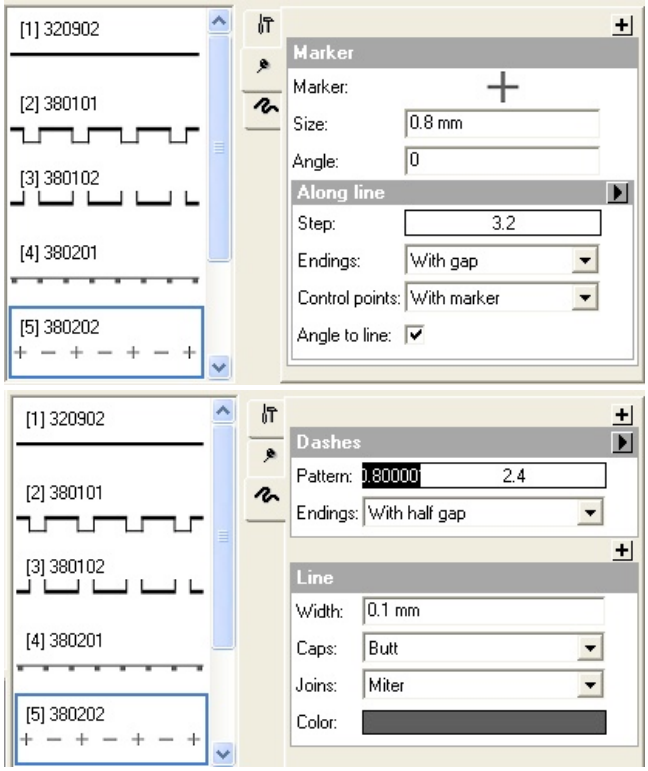
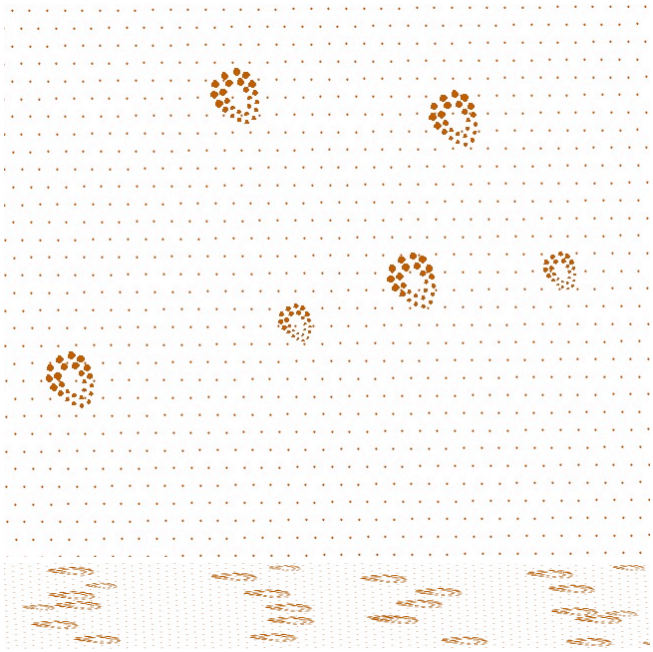


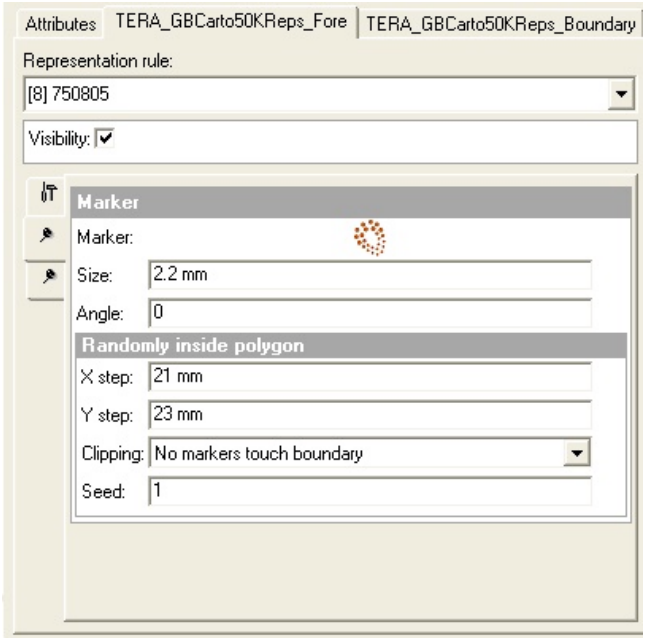
Fig.14(b) Two symbol layer of wire net

For polygon symbol, symbol layer is even more important. As shown in Fig.15, filled marker of dune is automatic repeat. Through individual parameters (Xstep, Ystep) settings shown in Fig.16, you can achieve different surface effects. As Fig.15 (b) shows, the dune's filled marker has repeat more frequently after reducing the Xstep and Ystep, instead of design another whole symbol for dune.



(a) (b)

Fig.15 Different effect of dune symbol



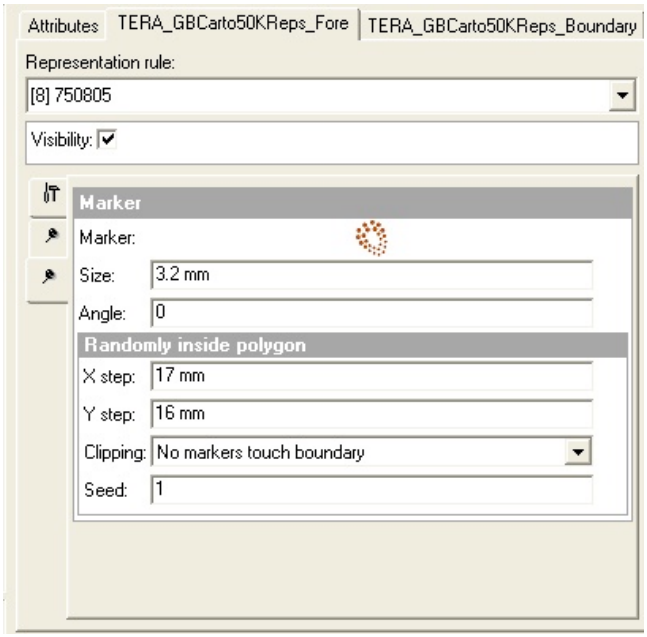


Fig.16 Two symbol layers of dune

CONCLUSION

The application example proves that the data organization model designed here is feasible and efficient, and greatly reducing the workload of manual editing.