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APPLICATION OF THE NUMERICAL MODEL OF LANDFORM IN SURFACE RUNOFF PREDICTION

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Abstract. *Surface runoff has recently been observed on the topographic map. The application of modern computer techniques in geodesy and hydrotechnics has expanded the possibility of surface runoff arrangement as well as for the formation of basic lines over the vector field.*

Key words: *numerical model of landform, surface runoff, hydraulic vector field.*

1. INTRODUCTION

Marsh surfaces are most likely to be seen in the valleys of large rivers and their torrential tributaries which, drifting their beds and preventing surface and ground waters from flowing away, cause considerable surface of soil to turn into a marsh. However, wet soils also occur on sloping peripheral parts of the valleys with ground waters filtrating from permeable layers, diffusing over downstream slopes. Water outflow is frequently difficult or prevented. In order to establish an optimum water-air regime, a network of open or buried conductors should be carried out to collect excessive water and conduct it to river banks or other recipients. The canal or drainage network arrangement depends upon numerous characteristics of the melioration area. For that purpose, when choosing the network, one should primarily study morphometrical, topographic and pedologic characteristics of endangered surfaces.

Until recently, topographic characteristics of the areas examined have been studied only through topographic and other kinds of maps and plans. Upon the introduction of automatic data processing in geodesy and cartography, it has become possible to establish a numerical model of landforms, and to give horizontal (using contour lines), axonometric or perspective view of terrains.

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2. Study Methods

Surface runoff has to do with excessive water. Generally, it is formed by precipitations and with certain retention it lasts somewhat longer, but still, its characteristics are disputable.

All surface runoff calculation methods may be classified in four groups:

1. methods established upon the ratio of precipitation and runoff;
2. methods of synthetic models of linear reservoirs;
3. water balance methods and
4. physical methods (1).

The above methods do not take into account landform of relevant areas, therefore this paper attempts to supplement relevant methods so that to make them practically applicable in e.g. drainage system design. One should especially pay attention to the determination of fall and vertical field line gradients, i.e. surface drainage flow lines, since this matter has been considerably neglected both in our and foreign practice.

One of the hydraulic vector field interpretations is (2):

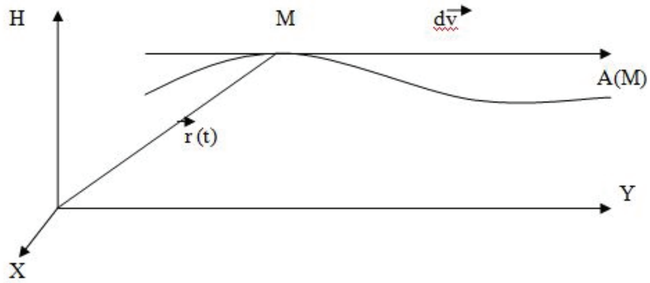

Fig. 1. Hydraulic vector field

Let us note the movement of incompressible fluid where the velocity of fluid particles, passing through point M, is expressed by vector A(M). The particles pass through point M over time, all at the same velocity dv, since the field is stationary, and therefore independent of time t. So, it is about an → actual physical vector field – fluid movement field. Fluid particle trajectories are vector field lines, since A(M) vector (Fig. 1) as a velocity has the direction of tangent trajectory. Pursuant to the given hydraulic vector field interpretation, field vector lines are frequently called flow lines.

→ Fall gradients of terrains and flow lines are closely connected to topographic characteristics of area, and hence, with excessive water drainage as well. Upon the introduction of automatic data processing, and pursuant to the expressions given in (2) and the relevant interpretation, we can get fall gradients.

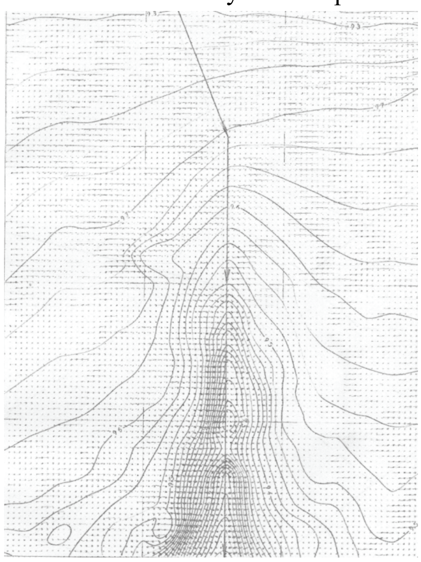

Fig. 2. The map of priority waterways

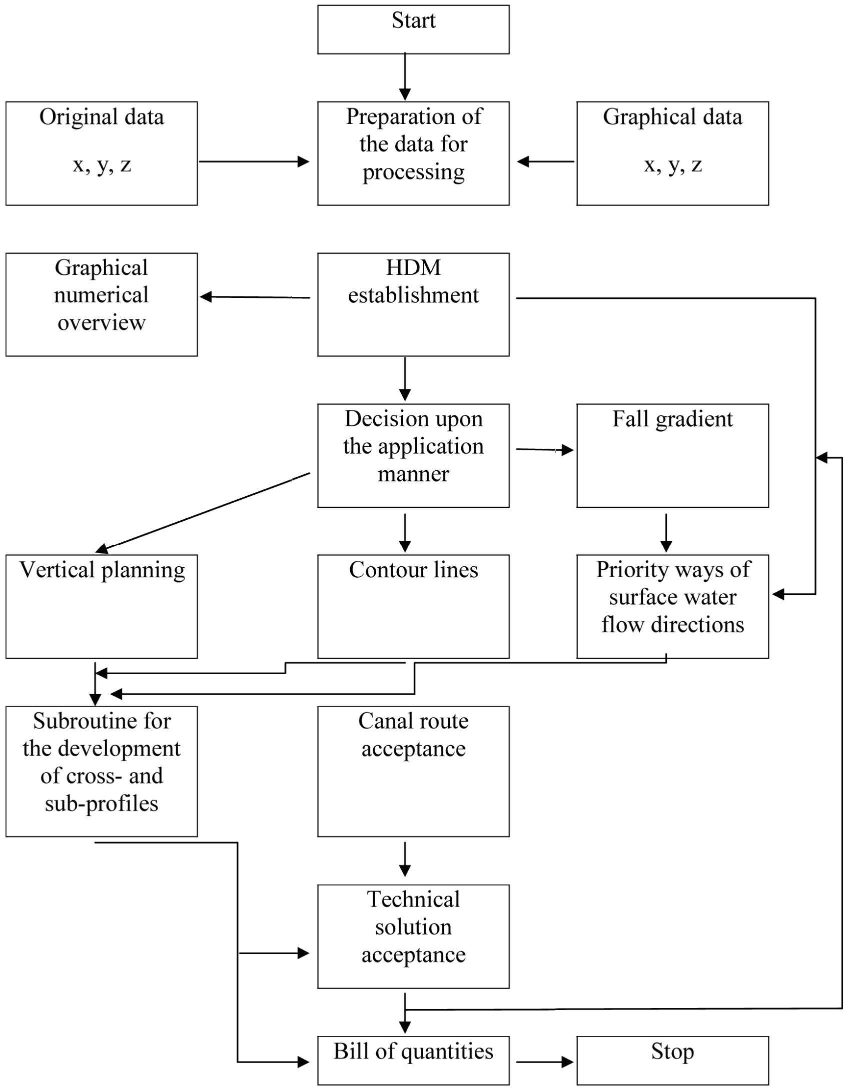

Diagram 1. Global plan of the Hydraulic Drainage Model (HDM) application

3. Results of Examination and Discussion

Surface water examination and study has been carried out on the actual example, shown in Fig. 2. For the needs of hydro melioration design, the terrain has been recorded by the tacheometric method. Recording has been carried out within the regular grid system. Thus, formation of the numerical model of landform is now easier, and automatic isohypses drawing has become possible. Each detailed point has been defined by the coordinates (xyH). Fall gradients are drawn in the detailed points defined in such a manner Mo.

Observing the fall gradients presented in Fig. 2, one may notice that, in the plain section of the terrain, gradients are less intense and therefore surface water runoff is, naturally, less intense, too.

The resultant of all fall gradients represents the main flow line of the area examined. Generalizing the main flow line one gets the future collector route, i.e. the surface water collector route. It has been defined by the coordinates (xyH) of the characteristic points within the model itself. Determination of the route limit values, e.g. Rmin, Imax etc. one gets the defined route with the defined coordinates To – beginning of the canal, T1 – canal route end point and T2 – end of the canal route, as well as all other geometric elements defining the canal route.

The complete procedure of application of the numerical model of landform in surface drainage, i.e. surface runoff, is presented in the global Diagram 1. This Diagram refers to the surface runoff problem solving by means of the automatic data processing.

CONCLUSION

The introduction of automatic data processing in geodesy and cartography has expanded the possibility of examination of certain phenomena closely connected to and dependent upon topographic characteristics of certain terrains. One of the possibilities to determine surface drainage, and thus the priority surface waterways, i.e. formation of the main waterway lines, is to determine through the fall gradients. This would remove subjective assessments and route determinations, e.g. of canals or other types of collectors.

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PRIMENA NUMERIČKOG MODELA FORME TERENA U PROGONOZI POVRŠINSKOG OTICANJA

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Površinsko oticanje se u zadnje vreme posmatra na topografskim mapama. Primena modernih kompjuterskih tehnika u geodeziji i hidrotehnici je dovelo do mogućnosti da se uredi površinsko oticanje i da se formiraju osnovne linije u vektorskom polju.

Ključne reči: *numerički model formi terena, površinsko oticanje, hidraulično vektorsko polje.*