R E P O R T on a training-visit to the Belgian Royal Meteorological Institute to familiarize with the HOMS-micro system (G06.3.01, H76.2.02, H76.2.04 and I26.2.01), by **Rimma Vedom**, responsible HNRC for Estonia

The main conclusions of my training-visit are:

1. I26.2.01 HOMS-component (Daily average areal precipitation by the Thiessen method) may be used by us without any adaptation, because we use the same standard method in manual work. Besides,we use the same method for calculation of large lakes' average
level (Peipsi lake - 3300 km2, Vortsjarv lake - 200 km2) and for average basin groundwater level.

2. G06.3.01 HOMS-component (Database management software for hydrological data) - we can use it as soon as some adaptations are done:
a) we need the four-times-a-day observation treatment (not yet existing in this component);
b) we need the facility of different annual table structures (for example, our standard demands the absolute extremes for daily mean tables).

Such an adaptation would be enough for our country to use this component. It is very important and very necessary for us because we still lack a unified system for primary processing and storage of data. G06.3.01-component, supplemented by HOMOGNIZ, provides such a system for the whole of our hydrometeorological observations.

3. H76.2.02-micro HOMS-component (Analytical fitting of stage-discharge relations) - can not be used by our country without substantial changes because the differences between our standard and their standards are very considerable. The key differences are:
a) in measurements (gaugings) production,
b) in measurements (gaugings) calculation,
c) in output of results.
The detail list of differences is given in Appendix.

4. H76.2.04 HOMS-component (Calculation of discharge by means of stage-discharge analytical relations) - we can use this component as soon as the package has been supplemented to enable:
- differentiation of gaugings by seasons or by river conditions implment;
- the relationship Q = f(H,T) to be used for the rivers with strong backstream phenomena.

Finally, the HOMS-micro four components (G06.3.01, H76.2.02, H76.2.04 and I26.2.01) can be used by the Estonian Meteorological and Hydrological Institute for creation, current processing and management of our hydrometeorological Databank.
We must translate all menus, screen and error messages into estonian. Two components - H76.2.04 and I26.2.01 - can be used by us without any adaptation as our standards in these fields are very similar or the same. G06.3.01 HOMS-micro component should be supplemented a little, and H76.2.04 can be used by us only after detailed joint changes.

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Appendix

H76.2.02 HOMS-micro component:

analysis of differences between international and Estonian standards of discharge measurements, processing and output

Use of the H76.2.02 HOMS-micro component by our country without any adaptation is impossible due to substantial differences between the international standard and soviet one used by the Estonian Hydrometeorological Survey for discharge measurement production, treatment and results output.

1. The differences between discharge measurement production.

Both in international and Estonian cases the stream discharge is the sum of the products of measured velocity and measured cross sectional area in subsections of a cross section.

1.1 Cross section area measurement

In the international method the number of the velocity and the depth verticals is equal. Our standard demands more accuracy in the cross section area estimation. Dispercion of the F = f(H) relationship (where F - total cross section area, H - water level) can not be more than 3%. So we measure the depth over each 1/20 : 1/25 of river width. It is necessery for the irregula shape of river cross section in natural channels. Due to the stability of most of our river beds we can generally use the same profile for a period from the last flood to the next one.

1.2 Velocity measurement

For an accurate value of average scheme velocity it is necessery to follow the standard frequency of measuring points i.e. by the vertical and horizontal position of the points.

Horizontal velocity distribution can be obtained by subdividing the river so that each subsection between 2 verticals does not let through more than 1/10 of the total discharge as per international standard. On the deep stream the minimal distance is obtained by the next equation:

$$dL = (F * hmax)/(10 * Vmax),$$

where dL - the distances on the deep stream,
F - cross section area,
hmax - biggest depth,
Vmax - biggest velocity.
On the littoral (near bank) zone the distances may be bigger.

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To obtain an exact average velocity at the vertical we use following number and the location of the measuring points in the vertical.

	Free channel	Vegetation and ice
h<75 cm	The number of measuring points depends on the diameter of a current meter propeller: near to the surface ("s",Vs) and near to the bed ("f",Vf), and on the regular depthes between these points, not less than the diameter of the used current meter propeller, or	
	0.6h (one point)	0.5h
h>75 cm	"s",0.2,0.6,0.8,"f"	"s",0.2,0.4,0.6,0.8,"f"
h>100 cm	integrated method of velocity measurement can be used.	

1.3 Measurement simplification

All these demands as per international standard are kept only for control measurements. Current measurements are done by more simple scheme for horizontal and vertical distribution of the measuring verticals and points.

For current measurements the following scheame of point position is used:

	Free channel	Vegetation and ice
h<35 cm	0.6h	0.5h
35<h	0.2h + 0.8h	0.15h + 0.5h + 0.85h
h>100 cm	integrated method of velocity measurement can be used.	

There are three models of simplification in our guides [1,2,3] for the horizontal simplification. These are:

1.3.1 Line-determine interpolation model (LDM) (the same as you use and I have checked by our simple gauging, but with full cross section area measurement),

$$Qldm = \sum_{m=1}^{n+1}(Fm*Vm) = \sum_{m=1}^{n+1}(Fm*Km(Vi+Vj)),$$

where Qldm - discharge calculated by simple LDM,
Km - coeficient depending on the vertical location and bank character (for internal verticales - 0.5).

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1.3.1.2 The method of representative verticals (RV) as one as way of LDM (for only 1 or 3 measuring verticals).

$$Qrv = F*K*Vr,$$

where Vr - mean velocity for one or three representative verticals,
K - coeficient from Vr to mean stream velocity.

The calculations by this method for our 27 outlets are given on the floppy-disk I left you (directory SRV).

1.3.2. Line-hydraulic interpolation model (LIH), which use hydraulic velocity dependance on the depth:

$$Qlih = \sum_{s=1}^{Ns} (fs*vs) = \sum_{s=1}^{Ns} (fs* [a (hs^{2/3}) + Ps (dvi + dvj)s]),$$

where fs - s subsection area,
vs - s subsection mean velocity,

$$vi = Vi + dVi,$$

vi - measured mean velocity in the i vertical,
Vi - hydraulic component of mean velocity

$$Vi = a * hi^{2/3},$$

dVi - casual fluctuations and measurement errors,

$$a = ai = 1/Nv \sum_{i=1}^{Nv} [vi/(hi^{2/3})],$$

Nv - velocity verticals number,
hi - i vertical depth,
hs - s subsection mean depth,
Ps - coeficient
Ps = 0.5 if 1<s<Ns
Ps = 0.7 if s=1 or s=Ns
s - subsection current number,
Ns - the number (amount) of subsections of a cross section,
i and j - subsection border vertical indexes.

LIH model is suitable when velocity distribution by width is coordinated with the depth distribution.

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1.3.3 Line-probable interpolation model (LPM) is the most accurate model. This model is not in our guide lines yet. It is the combination of LDM and LIH models.

$$Qlpm = K*Qldm + (1-K)*Qlih,$$

where K - coeficient of depth-velocity coordination power.

$$K = 1/N \sum_{i=1}^{Ni} (/Pv-Ph/i),$$

where N - the number of velocity verticals,

$$Pvi = (vi/Vmax)^{1/mv},$$

$$Phi = (hi/hmax)^{1/mh},$$

where Vmax and hmax - maximal velocity and depth fixed on this discharge measurement.

$$mvi = 1/N \sum_{i=1}^{Ni} (Ln(Vmax/vi)),$$

$$mhi = 1/N \sum_{i=1}^{Ni} (Ln(hmax/hi)).$$

This model is very suitable for ice and turbulent conditions (small depthes, big velocities, steep slopes, lot of stones etc). The program of simplification of discharge measurements by these three models (LDM, LIH and LPM) is given on the floppy-disk I left you (directory LIVR, file LIVR). All another files in this directory contain the results of this simplification for some stations.

1.4 Ice condition measurement.

H76.2.02 does not assume such conditions at all. We need a program for such conditions and we are ready to give necessery information for this program, if RMI will agree to write it.

2. The differences between measurement treatment

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I will not need to enumerate those differences of treatment, which are connected with measurement differences. These are clear. I must show the equations for mean velocity calculation in the verticals which differ.

Detailed measurements:
free channel conditions:

h<75 cm Vi = simple average, or Vi = V0.6
h>75 cm Vi = 0.05Vs + 0.347(V0.2 + V0.6) + 0.173V0.8 + 0.083Vf or
Vi = 0.1(Vs + 3V0.2 + 3V0.6 + 2V0.8 + Vf) if shape of velocity profile is "right"
Vi = measured velocity for integrated method of measurement

vegetation and ice:

h<75 cm Vi = simple average, or Vi = 0.9*V0.5
h>75 cm Vi = 0.1(Vs + 2V0.2 +2V0.4 + 2V0.6 + 2V0.8 +Vf) (like in Belgian)
Vi = measured velocity by integrated method of measurement

Current measurement:

Vi = measured velocity by integrated method of measurement for any channel conditions.

free cannel conditions:

h<35 cm Vi = V0.6 (like yours)
h>35 cm Vi = 1/2(V0.2 + V0.8)

vegetation and ic e:

h<35 cm Vi = 0.9?V0.5
h>35 cm Vi = 1/3(V0.15 + V0.5 + V0.85)

3. The differences between result outputs

For all our measurements we give the following results:

Q - total discharge, F - total cross section area, conditions in codes, Fl - part of cross section area which is not moving (dead area), Fi - part of cross section area which is occupied by hard or soft ice, Fa - "alive" cross section area, Va - stream average velocity, Vmax - maximum velocity, B - whole stream widht, Bl - moving stream width, h - average depth, hmax - maximum depth, method of measurement (amount of velocity verticals and measuring points). We use for analysis the following graphs:

Q = f(H), F = f(H), Fa = f(H), B,h,hmax,Va,Vmax = f(H).

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Graph output of cross section area with velocity, depth and subsection discharges distribution by the width, and vertical velocity distribution by the depth is the same.

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