EURASIAN WATER CONFERENCE
3rd ASEM Seminar on Urban Water Management
Urban solutions for global challenges
13-14 September 2018 Budapest
www.asemwaterbudapest2018.hu
INTERNATIONAL R/D TRENDS IN THE FIELD OF STORM WATER MANAGEMENT

Kálmán Buzás
Professor at the Dept. of Sanitary and Environmental Engineering, Budapest University of Technology and Economics
Chairperson of Storm Water Management Working Group of Hungarian Water Association
Hungary

www.asemwaterbudapest2018.hu
PARADIGM SHIFT IN URBAN DRAINAGE

GENERAL TARGET

Integrated urban water management based on urban stormwater management
PARADIGM SHIFT IN URBAN DRAINAGE
DRAINAGE SPECIFIC TARGET
Mitigation/sustention/ of risk of precipitation caused damages in spite of unfavorable conditions generated climate change

BUILT-UP ADAPTIVE URBAN DRAINAGE SYSTEM

www.asemwaterbudapest2018.hu
Urban stormwater management

Essential features of paradigm change:

❖ Rainwater is considered as renewable natural resource.
❖ Instead drain-off, the utilization and/or let to be utilized (infiltration) is the primary goal.
❖ Modification of urban watershed surface is determinant part of drainage system planning.
Urban stormwater management

DRIVING FORCES

➢ Accommodation to climate change
➢ Demand on efficiency improvement of urban water and wastewater public works
Urban stormwater management

Rainwater runoff quality must meet the requirements of utilization/infiltration.

Road runoff are mostly considerably contaminated with TPH, PAHs and a set of heavy metals, however, contamination of roof runoffs are little, easy to use.
Urban stormwater management

In the conventional (at the same time actual) approach, the hydrological characteristics of urban surface are considered as not to be changed. Its modification is not a part of drainage network planning.

In contrast, the modification of urban watershed surface is determinative task in urban rainwater management planning. The modifications aim at the improvement of rainwater utilization conditions, mostly by green areas.
Urban stormwater management

The technical system of urban stormwater management comprises more than just the drainage network itself. The system implies the whole hydrologic/hydraulic processes, that are besides the network processes the surface runoff, infiltration, evapotranspiration and the transport of pollutants on the urban watershed surface.
Urban stormwater management

Adaptability in changing climate conditions

To approach to the greatest possible extent the hydrological response of urban watershed to that of natural one.
Urban stormwater management

The suitable solutions and methods are diverse by settlements moreover by districts of a town, depending on:

- the proportion of impermeable surface,
- surface slope,
- soil and groundwater conditions, furthermore
- the drainage systems features (extent, maintenance, transporting capacity, combined/separated)
Basic types of built in extent: No.1

Low extent of built in area, family houses with gardens, proportion of green area is significant
Basic types of built in extent: No. 2
Densely built in area, apartment houses with gardens, proportion of green area is significant
Basic types of built in extent: No.3

Sparsely built in area, housing blocks, proportion of green area is not negligible.
Basic types of built in extent: No.4
Densely built in area, housing blocks, proportion of green area is almost negligible
The mightiness of climate change impact and the complexity of technical solutions increase
Strategic approach of urban stormwater management

3 levels management goals and technical solutions

First level: Local intervention for keeping back H mm precipitation;
H is the decision parameter (15, 20, 25 mm);
Technical solutions: LID control: utilization, infiltration

Second level: Flow control in the drainage network.
Technical solutions: Detention, retention ponds, infiltration; H: 20 – 40 mm

Third level: Dealing with extreme rain events. H>40mm
Technical solutions: alternative surface runoff routing, temporary flooding areas
First level: LID Control
Systematic application of local runoff control elements

LOCAL REGULATION
  =
REGULATION OF RUNOFF JUST AT THE PLACE OF ORIGIN
  =
REDUCTION OF PROPERTY DRAIN OFF

Targeted and expected effects are reduction of:
  • runoff volume,
  • peak discharge and
  • pollutants transport.
One example of 3rd level design approach: Temporary inundation area

Copenhagen, Master Plan
Inundation control by surface modification

Actual conditions

Modified surface during light rainfall

Modified surface during heavy rainfall
The role of green infrastructure in the urban rainwater management

AND

VICE VERSA

The role of urban rainwater management in the implementation of green infrastructure
Synergic interrelationships between the two fields

Green City ➔ Blue-Green City

Enforcement of urban rainwater management demands in the landscape architecture practice

Integration of landscape architecture practice into the implementation of urban rainwater management
The climate change, the IDF curves and the lost drainage service safety
Calculation of hydraulic discharge

Design rain event

Both the actual design practice and technical regulation apply the concept of design rain (IDF curves).

A rain event is considered as design rain if its duration equals to the concentration time of the given watershed.

However, in case of a drainage system, which contains reservoirs, besides the peak discharge the total runoff volume becomes design criteria, as well. The initial concept is not valid any more.
The hydrological memory of the watershed and the design rain

The role of

➢ soil saturation and
➢ recurrent rains

Reservoirs built into the drainage system significantly increase the watershed memory: actually/changing stored volume in reservoirs

Joint probability of occurrence. Different design rains for selected system states.

What should be the critical state of the system?
The safety level of the drainage service
Nowadays the safety level of the drainage service is considered as the return period of design rain.
The crucial problem at the urban hydrology is that this kind of safety interpretation has been lost, and we cannot get back anymore.
The lost drainage service safety

The return period was determined by the statistical evaluation of precipitation measurement time series got in era, in which we could rightly assume: the longer the period evaluated the more accurate the occurrence frequency.

This was based on presumption that the climate was varying but it did not show a trendy change.
The lost drainage service safety

However, 30-35 years ago the steadiness came to end, our fundamental presumption became incorrect, consequently the information content of former IDF curves began to decrease, even though it has not completely disappeared: there was a need for new IDF curves.

Whether the new IDF curves provide solution in changing climate condition?
The lost drainage service safety

The essential feature of IDF curves is that we get them from the evaluation of past observations. However, changing climate modifies, among others, the rainfall distribution during years, as well.

Consequently, the recalculated IDF curves based on the past 30-35 years remain likewise irrelevant in the future. Although the extent of their irrelevance is probably lower than that of old ones.

The life expectancy of drainage systems at the design phase is 50 years, but the real lifespan can reach up to 100 years or more. These periods of time are the same order of magnitude as that of projected serious change of our climate.

Sadly, the right answer to the above question is: NO.
How and where to go?

Weather generators (early 80’s, daily time resolution)

➢ need downscaling to 10 minutes, but
➢ the parameter dependence from climate change remains

Early warning systems, urban meteorological radar
How and where to go?
Local, low cost X band radar for urban environment

Resolution: 50-100 m. Range of measurement: 30 km.
Sampling frequency: 1 minute
How and where to go?

Smart metering network
Data transfer and processing
Real-time control based on AI

Green City

Blue - Green City

Smart City
THANK YOU FOR YOUR ATTENTION