QKan – Managing Urban Drainage Systems with QGIS

QKan

QGIS and database based system for managing urban drainage system data

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Introduction

What is QKan?
- Set of plugins for QGIS
- Database model

What can QKan be used for?
- Design of urban drainage systems in combination with hydraulic simulation software

Who can use QKan?
- Engineers in consulting offices
Why did the consultant offices give money for open-source software?

- Need for a software aiming at the specific workflow of an engineer
- Good opportunity to (make staff) learn QGIS
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Objectives

1. Urban drainage system data
   - Verification
   - Preprocessing

2. Hydraulic simulation *(external)*

3. Results
   - Analysis
   - Plans
     - Map of sewage system
     - Cross section
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Objectives

What do consulting offices need?

1. Workflow **independent** from simulation software

2. **Simple** data structure

3. **Flexible** import of sewage system data
   - Table data: ASCII, CSV, Excel
   - Database data: ACCESS tables
   - Data exchange formats: ISYBAU-XML, DWA-XML
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Objectives

Typical workflow...

1. Design of sewage system in an iterative process

- QKAN: data preparation
- Simulation package
- Export to simulation package
- QKAN: Preview of results
- Simulation package
- Synchronisation
- QKAN: Data Changes
- Report Maps
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Objectives

Widely used simulation packages

- HYSTEM-EXTRAN (ITWH, Hannover)
- Kanal++ (tandler.com, Buch am Erlbach)
- Mike Urban (DHI, Hørsholm, Denmark)
- Rehm Software (DHI, Hørsholm, Denmark)
- SWMM (EPA, USA)
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Not widely used in Germany…
… but several software packages originate from SWMM
Main functionality

1. Data import
2. Prepare data for simulation
3. Analysis of simulation results
4. Creating maps for printing

... using:
- QGIS
- QKan-Plugins
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Functionality

Import of network data

provided with a meaningful project file
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Functionality

Forms for data editing:
Plugins for managing surface areas:

- automatic linking to nearest pipe
- intersection of large surface areas (large building, traffic area)
- creation of surface objects from the space between impervious areas
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Functionality

Visualisation of simulation results

1. Network data
2. Hydrographs
3. Longitudinal section

... if there is no (free) viewer available
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Functionality

Thematic mapping

Special node types:
- Start node
- End node
- High point
- Low point
- Outfall node

Subcatchment types:
- im-/pervious
- user defined pervious types
Functionality provided by QGIS:

2. Create Map Layout

- CAD-file (*.dwg)
- export file (*.dxf)
- vector graphics (*.svg)
- QGIS
- QGIS-template (*.qpt)
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Design characteristics

GIS
1. QGIS

Databases
1. SpatiaLite
2. PostGIS (not yet)

Programming Language
1. Python

Forms
1. QT
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**Design characteristics**

- Operator of the sewage system
  - 1. long-lasting
  - 2. stable
  - 3. complex
- Consulting office
  - 1. flexible
  - 2. simple

**Database design**
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Functionality

Example: Automatic linking of impervious areas
How does it work? Spatial SQL!

1. Create new table from areas
2. Create buffer
3. Find nearest catchment intersecting with buffer
4. Create line
WITH tlink AS
  (
    SELECT f1.pk AS pk,
    Distance(hal.geom,f1.geom) AS dist,
    hal.geom AS geohal, f1.geom AS geofl
    FROM
      haltungen AS hal
    INNER JOIN
      linkfl AS f1
    ON MbrOverlaps(hal.geom,f1.gbuf)
    WHERE f1.glink IS NULL
  )
UPDATE linkfl SET glink =
  ( SELECT MakeLine(PointOnSurface(t1.geofl),Centroid(t1.geohal))
    FROM tlink AS t1
    INNER JOIN
      ( SELECT pk, Min(dist) AS dmin
        FROM tlink GROUP BY pk
      ) AS t2
    ON t1.pk = t2.pk AND t1.dist <= t2.dmin + 0.000001
    WHERE linkfl.pk = t1.pk
  )
WHERE linkfl.glink IS NULL;
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Functionality

Spatial SQL ...

1. Replaces a bunch of Python code
2. Benefits from indexing
3. Requires a powerful database
4. Requires multiple geometry columns

Does it really?
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Functionality

QGIS and Spatialite-DB

- map
- GUI
- data
- geo-processing

possible conflict!

while running a plugin there must no layer be editable!
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Experiences

There was a lot to learn besides creating the QGIS plugins:

- adapting a template project file to a new database → modification of XML files with a python xml parser
- Awesome QT editor for designing forms
- Writing documentation with Sphinx → automatically using comment lines in the Python code
- Handle the powerful logging/error-report mechanism
Conclusion

What will be next?

The QKan project is still in progress:

- Adaption to additional hydraulic simulation software packages
- More data handling plugins
- More result analysis plugins
Thank you!