Zukunft Bau

ABSTRACT

EVaSENS

Application of Vacuum-Inliners in existing buildings – Integration of vacuum sanitary systems in existing buildings in order to establish NASS systems.

Occasion/ Initial Situation

Neuartige Sanitärsysteme (innovative sanitary systems – NASS) are based on separate collection of the individual wastewater streams like graywater and blackwater at their point of origin. These individual streams can thus be exploited as resources. The project aimed to develop integrative solution approaches of pipeline redevelopment based on a new technical development for modernization implementation in existing buildings which allows to connect NASS.

Topic of the Research Project

After successfully researching the state of the art we went on to examine the existing building stock in Germany. This served to identify possible fields of application for the system in development. Afterwards first technical preliminary tests were conducted. Various inversion options were examined on the basis of an inliner system for small pipe cross-sections. In the process the double inversion with two liner cross-sections of different size proved to be a good possibility (fig. 1). This procedure variation was chosen as basis for all further examinations. During the further progression of the project the research group focused on implementing stress tests in order to determine the applicability under operating conditions. For this purpose three test systems with a height of 5.70 m were installed and inverted with two liners (fig. 2). The inversion was conducted successfully and with two workdays in a surprisingly short amount of time. Proof of this was furnished via camera inspection, leak tests and under-inflation tests of the newly created pipelines and the corresponding connections. Subsequent hydraulic stress tests were supposed to represent 4 to 6 story residential buildings with the drainage objects located on top of each other. In order to achieve this maximum flow quantities were applied accordingly to the test system. The Research was based on the DIN 1986 – 100 mentioned below:

- “The loss of seal water caused by the outflow process must not reduce the level of the odor trap by more than 25 mm.
- The seal water must neither be suctioned by negative pressure, nor must it be pressed out by overpressure.
- No larger nominal diameter than the one calculated according to this norm should be used for wastewater and mixed water pipes.
- Self-cleaning of the sewage pipe must be achieved.”

Determining the pressures at various points within the pipeline as well as the drain velocity with the available measurement during our initial field campaign we found great inaccuracies. Hence the maximum quantity was replaced by determining the change of the seal water. To do so an Ultrasonic Distance Measurement System for the determina-

tion of the water level inside pipelines was employed (fig. 3). The measurement system was installed at the connection which simulates the lowest floor (fig. 4). During three field campaigns hydraulic stress tests have been conducted at the graywater pipe resulting from the double inversion. This new pipe is characterized by a kidney-shaped pipe diameter, which so far is not yet being used this way in sewage pipes. In order to clarify possible deviation concerning the drain behavior of this new diameter all tests were also conducted on a standard DN 75 pipe as a benchmark (fig. 5). The remaining cross-section surface of the kidney formed in the DN 100 pipe is roughly 52 cm² which is consistent with a DN 80 pipe, which, however, is not an available standard size in pipeline construction. All three field campaigns subsequently showed a clear superiority of the new graywater pipe in comparison to the reference pipe. From this we were able to deduce that the flow behavior of fluids is not negatively influenced by the altered geometry of a pipe and that the entire available drain room can be utilized. Subsequent to the hydraulic stress tests a visual validation of this result was conducted. For this purpose a plexiglass pipe which had been deformed accordingly was installed in the first test system and ran colored water through it. This initial visual inspection hinted towards a confirmation of the results. In order to optimize the visual inspection of the flow behavior contrasting colored pellets (fig. 6) were added. The flow tests were then recorded with a high speed camera (200 frames per second). These recordings enabled us to overlay the single frames (tracking) to visualize the flow behavior on the basis of the pellet movements (fig. 7). The resulting footage showed an unimpeded flow behavior in both, the standard pipe and the kidney.

Conclusion

The research project EVaSENS aimed to develop new technology to enable a posteriori installation of wastewater separation systems at the point of origin in existing buildings. This goal was reached within the life span of the project. Furthermore the functionality and practicality of the method was examined and validated. Thus, it is now technically possible to connect existing buildings without great constructional effort to new infrastructural systems. However, the method could only be tested under laboratory conditions. Further technical challenges should be tackled with a practical realization in a real building.

Key Data

Short Title: EVaSENS

Researcher / Project Management: Prof. Dr.-Ing. Jörg Londong

Total Costs: 269,388.-€

Amount of Federal Subsidy: 180,806.-€

Project Life Span: 35 Months

IMAGES/ PLATES:

5 - 7 printable image files as **separate files** (*.tif, *.bmp, ...) with a minimal resolution of 300 dpi image scale (e.g. width of 10 - 20cm). Images are free from any third-party rights.

Image credits respectively:

Image 1: DSC0330.JPG
Liner in DN 100 und DN 50 as well as calibration tube before the inversion
Image 2: DSC 0112.JPG
Inversion drum with calibration tube
Image 3: DSC0315.JPG
Ultrasonic measurement system for determination of the seal water change during the tests
Image 4: Test stations 1 to 2 schematically.JPG
Schematical image of the test stations
Image 5: Test set-up with reference.png
Test set-up for examination of the drain flow of test system 2, replugged to the reference pipe
Image 6: pellets.JPG
Cleaning pellets for the cleaning of cooling systems by the Taprogge company