News from Lohmeyer

Lohmeyer Consulting Engineers | **Issue no. 44** | **December 2020**

Dear Readers

In these challenging times, we can be thankful that our offices have remained up and running despite distancing regulations and sometimes necessary periods of self-quarantining. As the year comes to a close, we would like to take the opportunity to offer you insight into the work we have conducted.

For many people, the shorter days in the autumn and winter months with little sunlight are difficult. Sufficient sunlight is also a critical consideration for residential building construction. Our first article offers a report on how we calculate buildings' external exposure to sunlight and how this affects natural room illumination on the inside. The basis of assessment has changed drastically with the new European standard DIN EN 17037 "Daylight in buildings" in comparison with the retired standard.

Some hope that the introduction of e-mobility will solve all pollutant-related problems. However, electric vehicles also produce non-exhaust fine particulate emissions. The second article addresses the current state of research on the modeling of fine particulates contained in the emissions produced by abrasion wear and resuspension in vehicles.

In chemical plants where hazardous substances are stored and processed, leaks can result in life-threatening situations. If an accident occurs, information is required as to whether a pollutant cloud will move in the direction of residential areas and if fire or disaster control services will be required to take action.

The final article introduces the latest, overhauled version of our system for modeling air pollutant dispersion during and after accidental releases at industrial installations.

I wish you all a joyful and blessed Christmas season and a happy new year. Stay healthy.

Yours sincerely
H. Lorentz

Striezelmarkt in Dresden 2020. Only the essence of Christmas remains.

BRIEF SUMMARY OF CURRENT NEWS

- The German Federal Environmental Agency and the German National Meteorological Service have conducted initial analyses of the impact of the coronavirus-related lockdowns on air quality in 2020. These identified a decrease in NO_2 of 23 ±6 percent owing to the lockdown. Depending on meteorological boundary conditions and the extent of the respective reduction in traffic, the impact of the lockdown on NO_2 concentration levels varied greatly both regionally and locally (Link).

- The final report on the German Federal Highway Research Institute's R&D project 70.0912/2015 "Dynamic environmentally sensitive traffic management," in which our office was involved (Link), has now been published and can be obtained from the specialist publisher Fachverlag NW under ISBN 978-3-95606-481-4.

- Current calculations of immissions along roads on the basis of HBEFA 4.1 show a common tendency to overestimate NO_2 concentration levels when chemical models are used for NO-NO_2 conversions. The main cause could be that HBEFA 4.1 significantly overestimates the proportion of direct NO_2 emissions. This is currently being investigated and assessed. You can look forward to reading about findings and recommendations in our next issue.

- We have redesigned our homepage. Have a look for yourself at www.lohmeyer.de.

CONTENT

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STUDY OF DAYLIGHT ON BUILDINGS PURSUANT TO DIN EN 17037

In building planning, daylight is a key aspect of consideration as regards the quality of time spent in interior spaces. Aside from any building spacing regulations, there are no legal specifications for building development planning with respect to daylight quality requirements. Previously, Part 1 of the standard DIN 5034-1 “Daylight in interiors” was typically used as a basis of evaluation. The standard DIN EN 17037 “Daylight in buildings” published in March 2019 established a Europe-wide basis for assessing the quality of daylight in interior rooms. The guideline includes general requirements and information for planning daylight openings and differentiates between room brightness and the time of exposure to sunlight.

Fig. 1: Sunlight exposure time on the façades (typical window geometry)

Time of exposure to sunlight: According to DIN EN 17037, a room should receive sufficient exposure to sunlight on any given date between February 1 and March 21, assuming cloudless skies (see **Fig. 1**). Three levels of sunlight exposure time are proposed (see **Tab. 1**). In line with the requirements laid out in DIN EN 17037, a room should receive at least 1.5 h of sunlight per day (low recommended level).

Recommended levels of sunlight exposure time	Sunlight exposure time
Low	1.5 h
Medium	3.0 h
High	4.0 h

Tab 1: Recommendation for daily time of exposure to sunlight pursuant to DIN EN 17037

A three-dimensional digital building model and a digital terrain model serve as the basis for determining the amount of time that the façades are exposed to sunlight. Numerical simulation calculations precisely determine the daily time of sunlight exposure down to the minute, taking into account shadowing from window reveals and lintels, balconies, loggias, surrounding buildings and/or topography. Times when the sun is positioned very low in the sky (<11°) are not considered in the determination of total sunlight exposure time in accordance with DIN EN 17037. At least one room of a residential apartment should be exposed to sunlight for a period calculated using **Tab. 2** when the recommendations are applied.

Room brightness: Pursuant to DIN EN 17037, the quality of brightness in a given room can be determined by recording a dot matrix of illuminance on a horizontal reference plane, which has a vertical distance of 0.85 m above the floor and a horizontal distance of 0.5 m to the walls (see **Fig. 2**).

DIN EN 17037 Annex 3 lists

Recommended level for vertical and inclined daylight openings	Target illuminance E_T lx	Fraction of the room for the target level F_{plane} %	Minimum target illuminance E_{TM} lx	Fraction of the room for the minimum target level F_{plane}	Fraction of daylight hours F_{time} %
Low	300	50 %	100	95 %	50 %
Medium	500	50 %	300	95 %	50 %
High	750	50 %	500	95 %	50 %

Tab 2: Recommendations for provision of daylight pursuant to DIN EN 17037

concrete target illuminance E_T and minimum target illuminance E_{TM} values as recommendations for daylight levels in rooms (see **Tab. 2**). The target illuminance should be achieved for at least 50% of the reference plane and the minimum target illuminance for at least 95%.

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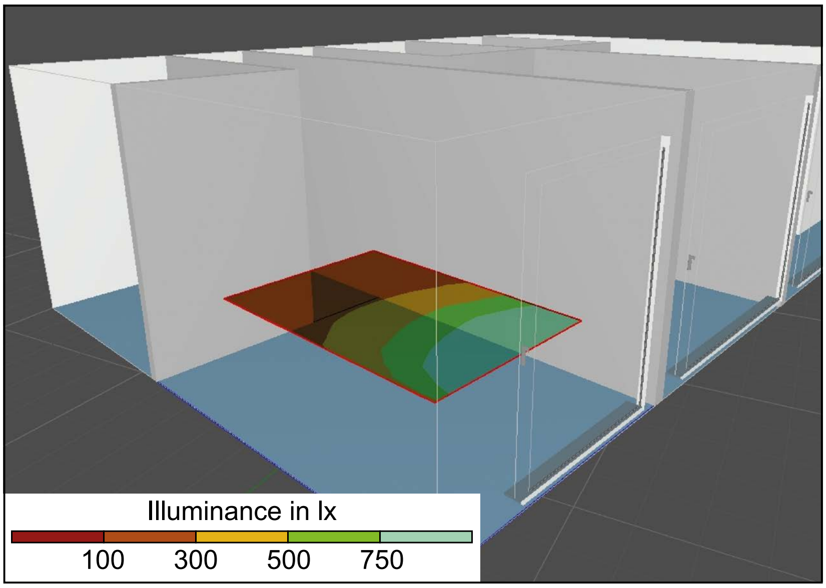

Fig. 2: Sample representation of a reference plane

QUANTIFICATION OF WEAR ABRASION PARTICLE MATTER FROM VEHICLES – CURRENT STATUS AND RESEARCH ACTIVITIES

In the past years, various air pollution control measures have effected a significant reduction in the air pollutant load, especially of particulate matter; yet measurements have shown that in some locations, limit values – in particular the daily limit value of 50 µg/m³ for particulate matter PM10 laid out in the 39th German Federal Immission Control Ordinance – are being exceeded, or model calculations forecast that they will be exceeded. Traffic-induced particulate matter emissions are caused by emissions from exhaust systems (exhaust particulate matter), by abrasions and by the resuspension of road dust. Non-exhaust particulate emissions are often referred to as abrasion wear and resuspension (AWAR) emissions. Non-exhaust particulate matter plays a decisive role, especially in view of decreasing motor emissions. Its share in the total emissions profile is rising due to an increase in low-emission vehicle fleets, e-mobility and more.

AWAR emissions could only be represented via alternative calculation approaches up through the HBEFA 3.3 (e.g. **[1]**). The HBEFA 4.1 now includes emission factors for PM10 and PM2.5 particulate matter for this source group as well. However, even this approach does not provide for sufficiently reliable differentiation when modeling the source of abrasion wear emissions.

A research project completed by the German Federal Highway Research Institute (BASt) in 2018 investigated the relevance and quantification of AWAR emissions **[2]**. The findings showed that, for example, ultrafine particles (UFP) from abrasion wear can be detected, as can new UFP in hot vapors generated by braking. A variety of different tracer substances are used for measuring brake and tire wear. Clutch wear does not seem to be of any significance. Toxicology studies indicate that abrasion wear has an impact on health, though according to the authors there is currently no direct (causal) evidence of this. Fewer adverse health effects have been attributed to tire wear than to other particulate matter (especially diesel particles). But the toxicological relevance of the contents of AWAR emissions (heavy metals, BaP, etc.) has not yet been sufficiently evaluated. The goal at the EU level is to ascertain the abrasion wear emission factors for brake and tire abrasion wear in typical driving cycles based on both mass and quantity. Among other things, the report also presented a qualitative overview of the methods available for measuring AWAR emissions in tabular form. In this table, the best possible practices were used as a basis for each evaluation.

A current R&D project conducted by the German Federal Highway Research Institute (BASt) will provide (initial) evidence of the ways in which certain attributes of German roadways impact abrasion wear. The project also presents the results of detailed calculations for AWAR using the NORTRIP (non-exhaust road traffic induced particle emissions) model. You can look forward to reading about the findings in one of the following issues of our newsletter.

References:

[1] Düring und Lohmeyer (2011): Einbindung des HBEFA 3.1 in das FIS Umwelt und Verkehr sowie Neufassung der Emissionsfaktoren für Aufwirbelung und Abrieb des Straßenverkehrs. Lohmeyer Consulting Engineers Expert advice commissioned by the Saxon State Office for Environment, Agriculture and Geology, Dresden.

[2] https://bast.opus.hbz-nrw.de/frontdoor/index/index/docId/1886

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SAMS – SYSTEM FOR MODELING AIR POLLUTANT DISPERSION DURING AND AFTER ACCIDENTAL RELEASES

SAMS is a system for the simulation of the dispersion of air pollutants during and after an accidental release at stationary or mobile sources. It calculates the airborne concentrations of a substance released at a given point in time as well as the expected future distribution across an area of approx. 30 km x 30 km, taking into consideration the meteorological conditions. The system can conduct these calculations for gases, liquid gases or liquids and the associated pool evaporation or vaporization. Based on this information, SAMS can identify endangered areas, enabling specific measures to be taken in a timely manner.

SAMS meets the requirements for a system for determining and assessing pollutant loads in cases of acute accidental substance release into the atmosphere in accordance with the guideline VDI 3783 Part 4 (2004). For an ongoing accidental release, a Gaussian Puff Model as defined by VDI 3945 Part 1 (1996) is used as a dispersion model. The Lagrangian dispersion model LASAT (https://www.janicke.de/en/lasat.html), which conforms to the guideline VDI 3945 Part 3 (2020), can be used for less time-sensitive accidental release analyses.

In Version 7, which is now available, the SAMS program interface has been fundamentally redesigned and adjusted to suit current standards. The user interface is based on GIS systems and, via a map manager, it offers the option of integrating customized local maps and/or Web Map Services (WMS) in addition to OpenStreetMap. The layered representation of maps, installations, measuring locations, wind fields, concentration grids and isolines provides users with a specific and clear visualization of the dispersion conditions. SAMS is able to read meteorological measurements, e.g. from ASCII files such as uSonic or CSV files, which supports the use of the integrated mesoscale diagnostic wind field model for factoring in terrain according to topography. The data can be accessed locally or over a network drive, or they can be made available via an implemented FTP or database client. SAMS can explicitly factor in the influence buildings have on the flow and thus the dispersion of pollutants released close to the ground by additionally integrating three-dimensional wind fields. This involves using the prognostic microscale wind field model MISKAM to generate a wind field library in advance. The integrated substance database with prescribed limit values has been updated and the interfaces have been renewed to enable more user-friendly regulation of all databases (scenarios, installations, monitor points).

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