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Transposition of CNOSSOS-EU into German Law

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ABSTRACT

One of the most important environmental issues in densely populated areas is the problem of noise. Traffic noise from cars, railway vehicles and airports located in close proximity to the city is not only annoying for residents; it also leads to serious health issues and has an enormous negative economic impact. In 2002, to improve the noise situation in Europe, the EU issued the Environmental Noise Directive (2002/49/EC). The aim of the Directive is to reduce environmental noise and to prevent an increase in noise in areas which are traditionally quiet. For this purpose, noise calculations are conducted for major roads, major railway lines, and various major airports with a high volume of traffic as well as large agglomerations. Until 2018, for this task a national interim method has been used. In 2019, it is replaced by a new calculation procedure, because the European Commission has developed „Common Noise Assessment Methods in Europe, CNOSSOS-EU". These methods have been implemented in Annex II to Directive 2002/49/EC in 2015. The transposition of this calculation procedure into German law will be explained in detail.

Keywords: CNOSSOS-EU, Noise, German law

1. INTRODUCTION

Environmental noise is an important issue causing one of the most common public complaints in Germany and within the EU. The German Environment Agency regularly conducts representative surveys to assess the impact of noise in Germany. According to the survey carried out in 2016, around 76 % of those interviewed complained of being disturbed or annoyed by road traffic in the vicinity of their homes [1]. Noise is not only annoying for residents; it also influences physical health: noise activates the hormone system and the autonomic nervous system. As a result, blood pressure and heart rate may change, thus affecting metabolism and its regulation. Biological risk factors such as blood sugar or blood clotting can change and lead to arteriosclerosis and hypertension or even heart attack. The risk of illness grows with increasing noise exposure. Due to this, it is of primary importance for city planners, engineers and politicians to make our cities quieter. For the assessment of a noise situation, different methods are applied in Germany.

2. TRANSPOSITION OF CNOSSOS-EU IN GERMANY

2.1 General approach

The European Environmental Noise Directive (2002/49/EC) requires the development of noise maps and action plans for traffic noise sources as well as noise from industry by the member states [2]. In Germany, this involves 70 agglomerations with around 24 million inhabitants, 49,000 km of motorways and major trunk roads, 14,000 km of major railway lines and all eleven major airports. For this task interim noise calculation procedures has been used so far in Germany because there was no harmonized European method available. This situation has changed with the introduction of common noise assessment methods pursuant to Article 6 of the Environmental Noise Directive by the European Commission in 2015. These methods have been implemented in Annex II to Directive 2002/49/EC [3].

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The methods comprise detailed noise calculation procedures for road traffic, railway traffic and air traffic as well as industry. For the application of CNOSSOS-EU in Germany, a transposition into national law was necessary.

The objective of the German Government is to improve the quality of noise maps and the comparability of results throughout Europe and create a solid basis for future policy on the management of environmental noise. Therefore, the methods should be designed in such a way that they can be easily applied in practice. Moreover, a comprehensive and systematic quality assurance for the calculation process is needed. To reach these goals, the following steps were carried out for each noise calculation procedure:

- Checking calculation formulas and parameters
- Closing of interpretation gaps
- Investigation of availability and quality of input data
- Definition of national default data
- Development of test cases and reference results for each noise source
- Definition of standardized import/export formats for software products.

For this purpose, the German Environment Agency has commissioned a research project to a consortium under the leadership of the German company Wölfel Engineering. In this project, interpretation gaps concerning the noise calculation procedures were investigated and closed. Furthermore, a test procedure for the implementation the CNOSSOS-EU noise algorithm into software was developed by the contractor. In the following this process will be explained at the example of the aircraft noise calculation.

2.2 Example aircraft noise calculation

For aircraft noise a procedure is described in CNOSSOS-EU which is based on a method contained in the 3rd edition of document 29 of the European Civil Aviation Conference (ECAC). It divides the three-dimensional flight path into appropriate segments of length. This segmentation procedure consists of two steps. The first step is an arc-segmentation of the flight route in the horizontal plane which is combined with a segmentation of the height profile in the vertical plane. Then the segments will be further subdivided based on acoustic and geometric criteria. This process leads to numerous segments which describe take-off, airborne and approach phase of the aircraft. For the noise calculation CNOSSOS-EU uses an “Aircraft Noise and Performance Database (ANP)” which contains many civil aircraft. For these aircraft, engine performance coefficients and Noise-Power-Distance (NPD) data are given. The NPD data are an essential acoustic element of CNOSSOS-EU. They consist of maximum and time integrated weighted sound pressure levels as a function of distance for different engine power settings.

For the description of height profile, two different types are used. Standard operational parameters define fixed-point profiles. These parameters are altitude, flight speed and engine thrust of the aircraft. The second type are procedural profiles which depend on actual aircraft mass, take-off or landing procedures and meteorological conditions. The aerodynamic and performance parameters are listed in the ANP database.

A detailed analysis of the CNOSSOS-EU aircraft noise algorithm showed that additional produces and data are necessary to describe the operational situation at German airports. For instance, the algorithm does not consider traffic circuits. However, traffic circuits are conducted at several airports in Germany. Consequently, an algorithm for traffic circuits is implemented in the German transposition of CNOSSOS-EU. Moreover, fix point profiles for most aircraft types operating at German airports are also added. Furthermore, the instructions on the acquisition of flight operational data described in CNOSSOS-EU are substantially extended. This aircraft noise calculation procedure is called “Calculation Method for Environmental Noise of Airports, BUF”. This set of rules consists of instructions on the data acquisition at airports and the calculation algorithm with an associated database. The instructions on the data acquisition contain elements and procedures that have proven to be useful for the establishment of noise protection areas according to the German Act on Protection against Aircraft Noise [4].

To ensure that the CNOSSOS-EU algorithm is correctly implemented in noise calculation software, a test case was developed which comprises five typical flight operational situations. The situations are combined with three different aircraft types so that a total of 15 variants is considered.

Since no reference results are available, the results of three different software packages are compared. If these results are within a margin of 0.1 dB, it is assumed that the CNOSSOS-EU algorithms are implemented correctly. In addition to the test case a standardized interface for data exchange according to the German standard DIN 45687 [5] was developed.

3. CONCLUSIONS

According to the EU Environmental Noise Directive environmental noise pollution is determined across Europe. For ensuring comparability of noise maps, a coherent and practical set of parameters is required. Therefore, national default input data is added, e.g. for trams and flight profiles for aircraft. Within the framework of the transposition of CNOSSOS-EU in Germany several issues are clarified and interpretation gaps concerning the calculation algorithm are closed. For instance, the determination of the number of schools and hospitals. The software implementation of the noise calculation method has to be quality assured. For this purpose, test cases are developed and a standardized interface for data exchange is defined. These modifications enable a consistent and practical calculation of environmental noise. The implementation of CNOSSOS-EU in Germany [6] therefore meets the requirements of the Environmental Noise Directive and fits the purpose of noise mapping.

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