

# Harmonizing noise abatement and urban development

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## Summary

In Switzerland, noise abatement is based on the principle that noise exposure should be reduced by measures at source or along the propagation path as well as by precautionary measures of spatial planning to prevent housing developments in noisy areas. As it is not always feasible to impose a sufficient reduction of noise emission, especially in areas of aircraft noise exposure, there remain considerable areas in urban regions banned from construction due to the precautionary principle of noise abatement. The problem is particularly intense in the greater area of Zurich where during nighttime hours the noise exposure of the airport covers large areas of the entire canton.

Therefore, Switzerland has recently adapted its noise abatement ordinance in order to optimize the process of weighing interests with regard to noise protection and urban development. The new regulation widens the possibilities of constructing new houses in noisy areas under the conditions that excessive noise exposure only prevails in the hours from 22:00 to 24:00. Furthermore, no aircraft traffic must take place from 24:00 to 06:00, new buildings must be acoustically well insulated, and the bedrooms must be air and temperature conditioned, and equipped with soundproof windows with an automatic closing and opening mechanism.

The new regulation is a paradigm change as noise protection of the population is partly shifted from noise reduction at source to insulating buildings. However, as the provision is limited to two hours in a time where most people are thought to stay inside their houses, it is supposed that the population is still sufficiently protected against aircraft noise.

PACS no. 43.50.Sr Community noise, noise zoning, by-laws, and legislation

## 1. Introduction

The Swiss Environmental Protection Act (EPA) [1] and the Noise Abatement Ordinance (NAO) [2] have the goal to protect the population against annoying or harmful noise. The principals to reach this goal are mainly the precautionary principle and the definition of exposure limit values. Noise abatement regulation in Switzerland specifies three types of exposure limit values:

- **Planning Value (PV):** Noise below this level should only be marginally annoying.
- **Impact Threshold (IT):** Noise below this level should not seriously disturb the well-being of the population, which is synonymous to "not being highly annoyed". The IT is usually about 5 dB above the PV.

- **Alarm Value (AV):** Noise above this level is extremely annoying. The AV is usually about 10 dB above the IT.

Transport infrastructure as well as industrial facilities and shooting ranges have to comply with the limit values. Additionally, the limit values are relevant for precaution in spatial planning to prevent housing developments in noisy areas. PV have to be respected in the designation and development of building zones. In noise affected building zones, it is only allowed to construct new buildings with rooms sensitive to noise if the IT are respected or if there is an overriding public interest to construct the buildings.

As it is often not feasible to impose sufficient reductions of noise emissions, especially for aircraft noise, there remain considerable areas in urban regions that are banned from construction. The problem is particularly intense in the greater area of

Zurich where during the night hours the noise exposure of the airport covers large areas of the entire canton.

2. Legal regulation for aircraft noise in Switzerland

Limit values are stricter during nighttime to protect the very sensitive time of sleeping. Three different assessment periods exist for aircraft noise: day: 6:00 to 22:00, night 1: 22:00 to 23:00, night 2: 23:00 to 24:00 and night 3: 5:00 to 6:00. There is a flight ban from 24:00 to 5:00 in Switzerland, but delayed flights are allowed until 00:30. The delayed flights are included into the period from 23:00 to 24:00. The exposure limit values also depend on the sensitivity of the reception point. There exist four different sensitivity levels in Switzerland: leisure zones, residential zones, mixed zones (residential and industrial), and industrial zones. Table I gives an overview of the exposure limit values for aircraft noise for residential zones.

Table I. Exposure limit values for aircraft noise in dB(A) for residential zones

	<i>PV</i>	<i>IT</i>	<i>AV</i>
Day: 06-22h	57	60	65
Night 1: 22-23h	50	55	65
Night 2: 23-24h	47	50	60
Night: 24-50h	Flight ban		
Night 3: 05-06h	47	50	60

Noise immissions are determinated at the open window of noise sensitive rooms, as for example of a bedroom or a living room. Determining the noise at the open window should ensure that the residents are not only protected against annoying or harmful noise inside the building but also in the surroundings. New building zones for buildings with rooms sensitive to noise can only be designated or developed in areas where the disturbance of the noise exposure is marginal, or in other words, where noise exposure does not exceed the PV as shown in Figure 1. The compliance with the limit values can also be reached by planning, design or structural measures, as for example the construction of a noise barrier or by orienting the noise sensitive rooms away from the source of noise. The enforcement authorities can grant exceptions for development of small sections of building zones. If the IT are exceeded, new buildings and significant

modifications may only be authorized if the values can be respected by planning, design or structural measures. If the IT can still not be respected, planning permission may only be granted if there is an overriding interest in constructing the building and if the cantonal authorities agree.

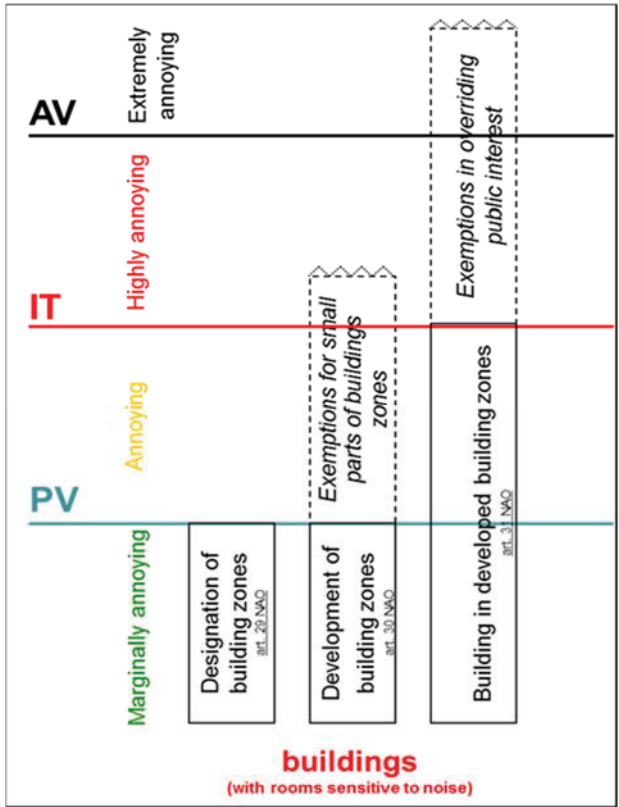


Figure 1. Overview of the relevant exposure limit values for buildings with rooms sensitive to noise. As the aircraft noise is coming from above, there are no such planning, design or structural measures possible in order to respect the limit values. Therefore, there are large areas around the international airports of Switzerland banned from construction.

3. Spatial planning precaution regarding aircraft noise

3.1. Conflict between urban development and noise protection around airports

Around Zurich airport - and to a smaller extent around other airports - there are areas with good access to transport connection, which could not be built on because of aircraft noise. This is in conflict with the spatial planning, which promotes the densification in the centres. In addition, the affected municipalities often would like to develop and to grow. Therefore, they asked to increase the

residential use of existing buildings by renewing the residential area, as well as to designate and develop building zones and use them for houses even if the exposure limit values for aircraft noise are exceeded. As a compensation, the new buildings should be built using modern construction methods. The legal framework for a solution was that the EPA should not be adapted, but only the ordinance. Furthermore, the flexibility in the spatial planning has to be in accordance with the EPA requirements of health protection of the residents. These requirements are specified by the definition of exposure limit values. The relevant values are the PV for designation and development of new building zones. This means that the population should not be annoyed more than marginally by aircraft noise.

### **3.2. Solution for harmonizing urban development and protection against aircraft noise**

A working group of the Federal Offices of Civil Aviation, for Spatial Development and for the Environment and of the canton of Zurich evaluated various solutions. The finally elaborated regulation now provides the opportunity to designate and to develop new building zones and to construct in aircraft noise affected areas under certain conditions. These are:

- The PV and IT are only exceeded between 22:00 and 24:00.
- There is no air traffic between 24:00 and 6:00 according the operational regulation.
- The new buildings must have an adequate acoustic insulation against external and internal noise. These are in particular the stricter requirements of SIA Standard No. 181 of the Swiss Society of Engineers and Architects [3].
- Bedrooms must be equipped with soundproof windows, which automatically open during non-flying times and close when air traffic starts.
- An appropriate room climate is ensured in bedrooms.

The day limit values have still to be respected. The regulation is restricted to the hours between 22:00 and 24:00, as most of the people are staying inside the house during this time. Inside the house, it is supposed that the population can be protected against annoying noise by the above-described criteria even though the PV and the IT are exceeded

in the surroundings of the buildings. However, if noise exposure exceeds the AV, it is no longer possible to exclude annoying noise inside the building even with good noise insulation.

Moreover, there should be no aircraft noise during the sensitive time between 24:00 and 6:00, where the major part of the population is sleeping. As the condition of no traffic during the main nighttime is only fulfilled for airports, the regulation is restricted to aircraft noise. It is not applicable to other noise sources.

The new regulation focuses on new or significant modified buildings, therefore the implementation of the constructional requirements should not pose any problems. An automatically opening and closing soundproof window has to be installed in bedrooms to make sure that inhabitants do not have to get up in order to open the window during the flight ban and to close it in the early morning hours when the air traffic begins. The installation of such a window has two reasons: Cooling in summer by opening the window is very effective and energy efficient. Additionally, representative surveys [4] showed that a large part of the population sleeps with half or entirely open windows throughout the whole year. Thus, there seems to be a need to sleep with open windows independent of thermal reasons. Modern constructions that no longer allow the opening of windows can therefore not completely meet this need. Consequently, it is important that residents can still open the window and that there is at least a certain period at night, in which it is possible to sleep with open windows without being disturbed by aircraft noise.

A study of the Lucerne University of Applied Sciences and Arts [5] showed that there are significantly more hours of overheating for buildings with windows closed from 22:00 to 24:00 and in the early morning hours compared to buildings with no restriction in window-opening. Therefore, it is crucial that aeration and cooling of bedrooms are given special attention. The goal of an appropriate thermal comfort and air quality in bedrooms can be achieved by technical, structural or other solutions.

It is supposed, that if all conditions for flight operation and for the noise sensitive rooms are fulfilled, the population is sufficiently protected against annoying aircraft noise. Figure 2 summarizes how the existing and the new regulation ensure the precaution in spatial planning in aircraft noise affected areas.

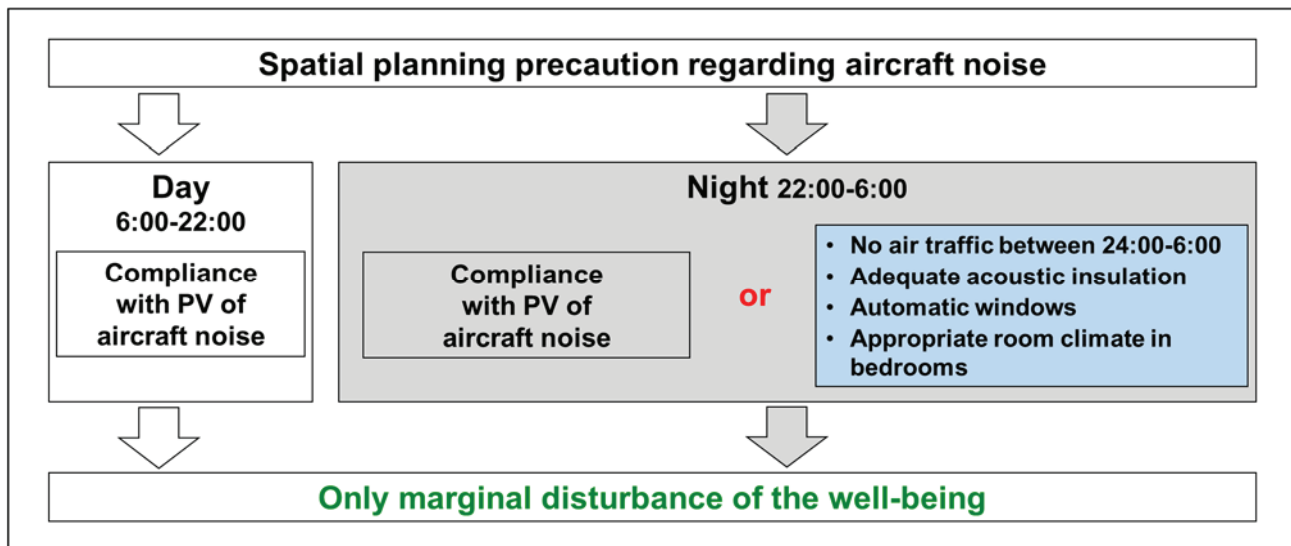


Figure 2. Overview of the existing and the new regulation concerning precaution in the spatial planning in aircraft noise affected areas.

### 3.3. Advantage and disadvantage of the new regulation

The new regulation provides more flexibility in spatial planning and in the settlement development of areas, which are well equipped with transport infrastructure. It enables the municipalities around the airport to densify the urbanization. So far, the regulation is restricted to the airport of Zurich, as this is the only international airport in Switzerland with no air traffic between 24:00 and 6:00. The airport even extended the flight ban to 23:30 to 6:00, including delayed flights, so that there is no air traffic between 24:00 and 6:00. Therefore, the regulation enhances the motivation for other airports to prolong their non-flying time.

The population remains largely protected against harmful or annoying noise. However, for the period from 22:00 to 24:00 the protection is only ensured inside the building. The constructional measures that compensate this disadvantage lead of course to somewhat higher building costs for the building owner. On the other hand, the land price is very high in Switzerland as it is a scarce resource. Thus, the additional costs for the construction are acceptable.

The special regulations for constructing in noise affected zones concerns only aircraft noise. However, the pressure now increases to expand this relaxation to other noise sources.

## 4. Conclusion

The new regulation is a paradigm change as noise protection of the population is partly shifted from noise reduction at source to insulating buildings.

The protection is only guaranteed inside the house and not anymore in the surroundings. However, as the rule is limited to two hours in a time where most people are thought to stay inside their houses, it is supposed that the population is still sufficiently protected against aircraft noise.

## References

- [1] Federal Act on Protection of the Environment of 7 October 1983 (Environmental Protection Act, EPA, SR 814.01).
- [2] Noise Abatement Ordinance of 15 December 1986 (NAO, SR 814.41).
- [3] Swiss society of engineers and architects: Schallschutz im Hochbau – Norm 181 der Schweizerischen Ingenieur- und Architektenverein, Zürich, 2006.
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- [5] N. Vetterli, D. Lüthi: Abklärungen zu Lüftungs- und Kühlungsbedingungen in Fluglärm belasteten Gebieten, Lucerne University of Applied Sciences and Arts, 2013.