Towards an Introduction of Low Frequency Spectrum Adaption Terms in Norwegian Building Legislation

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Abstract

The Norwegian Standard for sound classification of buildings, NS 8175, was revised in 2019, with the one significant change being that low frequency spectrum adaption terms were made mandatory for dwellings. Almost six years later, the new version of the standard is yet to be adopted into the legislation by the Norwegian Building Authority. The main reasons behind this delay are that the inclusion of low frequencies will increase the already high costs of building, and that it might also pose a threat to the traditional Norwegian building style. Nevertheless, the authorities are now indicating that the standard will be adopted within 2026. In this paper, the change will be discussed from a test institute's point of view, looking at issues, opportunities and whether the building industry has spent these six years wisely.

Introduction

In 2019, the revision of the Norwegian Standard NS 8175 was finalised [1], replacing the old NS 8175:2012 [2]. There were mostly minor changes to the standard following the revision, but also one significant change. Previously, the use of low frequency spectrum adaption terms between dwellings had been limited to class A and B, but in NS 8175:2019, they were also included in class C, see Table 1.

Table 1: A summary of the requirements for sound insulation between dwellings in class C in NS 8175

	NS 8175:2012	**NS 8175:2019**
Airborne sound	$R_w \geq 55$ dB	$R_w+C_{50\text{-}5000} \geq 54$ dB
Impact sound	$L_{n,w} \leq 53$ dB	$L_{n,w}+C_{50\text{-}2500} \leq 54$ dB

When it comes to sound insulation, NS 8175 is the most important document in Norwegian building legislation. Class C in the standard is referred to in "Byggteknisk Forskrift (TEK17)" [3], which regulates the technical specifications for new Norwegian buildings. Essentially, by ensuring compliance with class C in NS 8175, one is also complying with TEK17.

However, TEK17 is specifically referring to NS 8175:2012, and there is no automatic updating of TEK17 when a new standard is published. So, despite NS 8175:2012 being *withdrawn* by Standards Norway, it is still the reigning version of the standard in TEK17.

This obviously leads to confusion, but also to a great deal of uncertainty in the Norwegian building sector. It is established that new and stricter requirements are in the pipeline, but no one knows exactly when these requirements will come into effect. Although at the latest, it should happen with the next revision of TEK. After TEK was first introduced in 1997, replacing a series of less comprehensive legislation, revisions have taken place in 2007, 2010 and 2017, so logically, a new version is expected within the next few years. The authorities have indicated that NS 8175:2019 might be adopted into TEK17 before that, possibly within 2026.

The consequences of stricter requirements

There is said to be two main reasons for the delay in the adoption of the new standard. The first reason is that by making requirements stricter, the cost of building will increase and add further stress to a Norwegian housing market where prices already are too high and activity in the building sector too low. The second reason is that traditional Norwegian building style is largely based on wood, and especially for impact sound, it is more difficult to obtain satisfactory insulation in a wooden construction than in a concrete construction.

The first reason is certainly correct, but it's not within the scope of this paper to assess the cost benefit of stricter requirements for sound insulation. As for the second reason, Løvstad and Limmesand assessed the technical consequences in 2021. They found that light-weight wooden constructions would need increased cavities, stiffness or mass, but concluded that building within the new regulations certainly would be doable [4].

This is also backed up by "Byggforskserien", which is a guideline for buildings published by SINTEF [5]. Byggforskserien consists of around 800 individual guidelines, and roughly 10 % of those are related to acoustics and sound insulation. The series is widely used in Norway. Essentially, TEK tells Norwegians what the requirements are, and Byggforskserien tells Norwegians how to meet those requirements.

In Byggforskserien, SINTEF have been recommending the inclusion of low frequency spectrum adaption terms for years, and thus satisfactory solutions must be shown in the series. In other words, SINTEF have been providing the building industry with solutions for how to satisfy these stricter requirements long before NS 8175:2019 was published.

What is the market doing?

Through Byggforskserien and our laboratories, SINTEF have a unique position in Norway. This has led to the establishing of SINTEF Technical Approval in the 1990's. A SINTEF Technical approval "*states that a construction product is considered suitable for use, and that it meets the Regulations on technical requirements for construction work*

(TEK), provided the areas of use and conditions specified in the approval document are followed"[6].

Technical Approvals can be issued for a range of products, including prefabricated building modules and elements, where sound insulation properties often are among the declared properties, see Table 2.

Table 2: A list of the number of Technical Approvals where sound insulation properties are declared for different product types

Product type	Number of Technical Approvals[1]
Building modules	15
Wall elements	23
Floor elements	20
Floor heating systems	4

[1] Where sound insulation properties are declared

In some of these Technical Approvals, low frequency spectrum adaption terms are included, either fully or partially. When fully included, the elements or modules covered by the approval will satisfy the requirements in NS 8175:2012 including low frequency spectrum adaption terms. When partially included, the approvals usually cover several variations of walls or floors where one or more of these variations satisfy the requirements in NS 8175:2012 including low frequency spectrum adaption terms. See Figure 1 for a graphical representation of how many approvals satisfy these requirements.

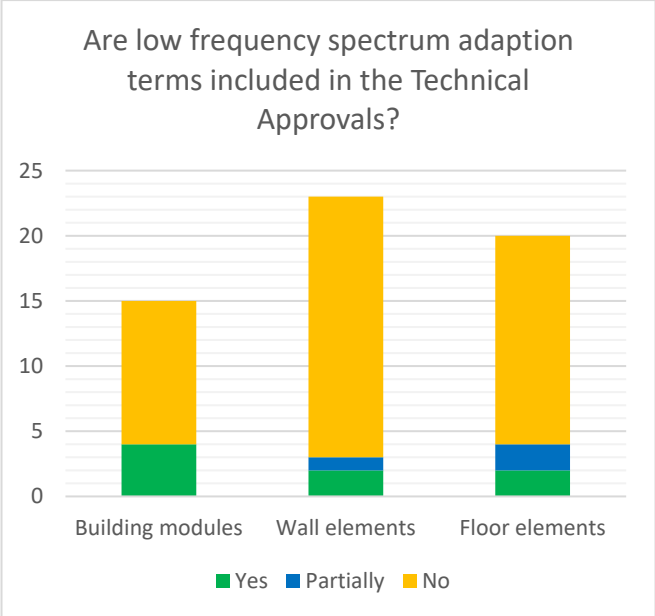

Figure 1: A graphical representation of the number of Technical Approvals for building modules, wall and floor elements

Although these numbers might not immediately look that encouraging, it's important to keep in mind that the low frequency spectrum adaption terms are not part of the legislation yet. What the figures are showing is that some manufacturers are choosing to deliver improved products that go beyond the requirements of today's legislation, and that means that satisfying the requirements in NS 8175:2019 is a matter of choice rather than a matter of ability. And because the solutions in the Technical Approvals all are relatively similar, it should be unproblematic for the other manufacturers to alter their products when the time eventually comes.

This is supported further by looking at the individual approvals' issue dates. In Figure 2–Figure 4, the data in Figure 1 are divided into before and after 2019 for each of the three product types.

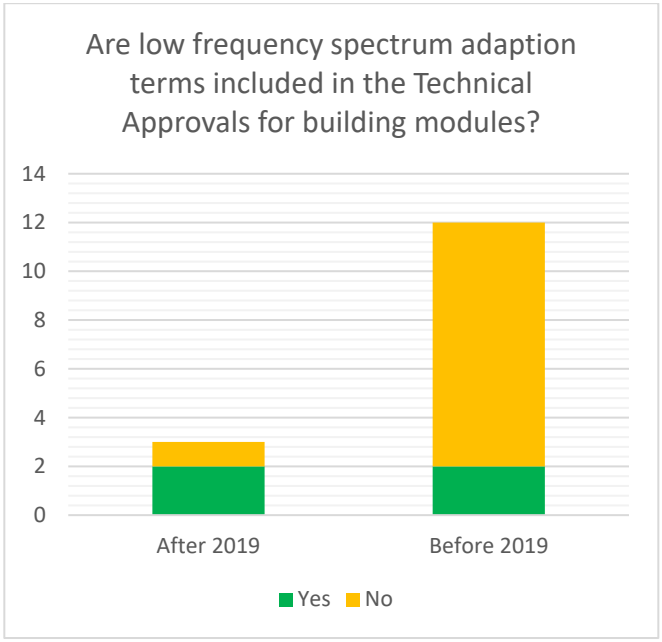

Figure 2: A graphical representation of the number of Technical Approvals for building modules, divided by issue date

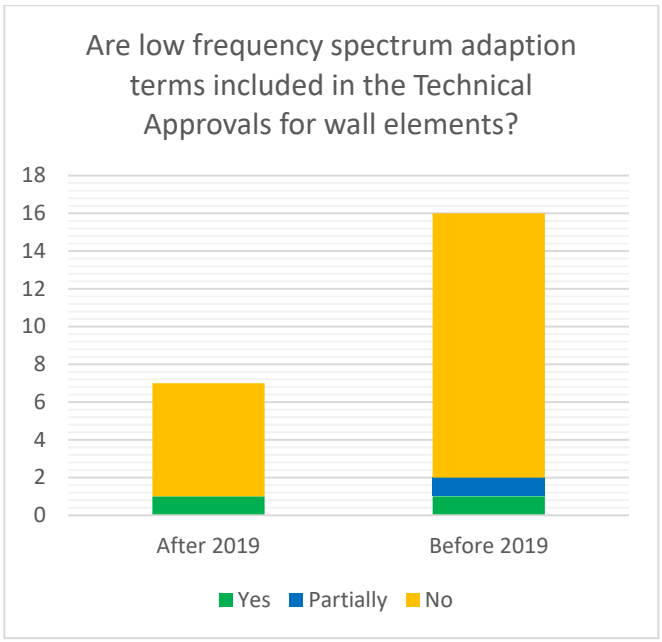

Figure 3: A graphical representation of the number of Technical Approvals for wall elements, divided by issue date

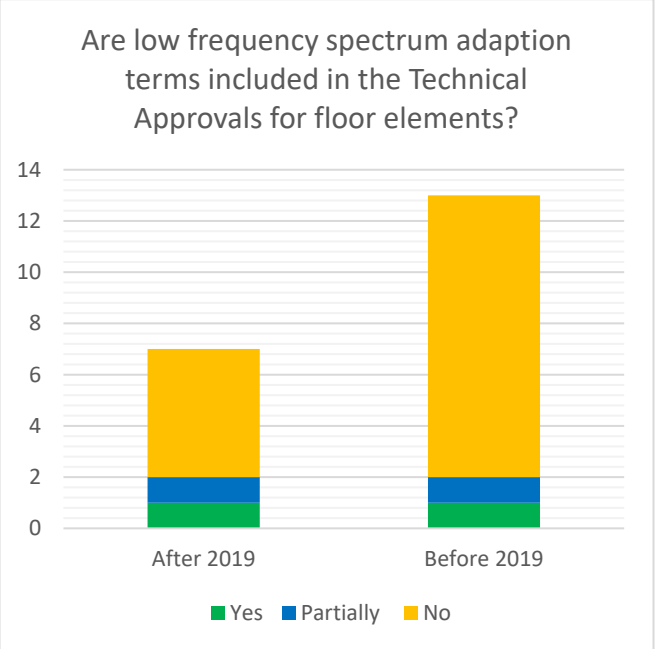

Figure 4: A graphical representation of the number of Technical Approvals for floor elements, divided by issue date

From the available data, there is a clear tendency that a larger portion of approvals issued after 2019 are satisfying the requirements in NS 8175:2019 than for the approvals issued before 2019. In Figure 5, the approvals that do satisfy the coming requirements have been examined further. Note that several of the Technical Approvals from Table 2 are overlapping, i.e. one and the same approval might cover both wall and floor elements and thus be counted twice in Figure 1. The numbers displayed in Figure 5 are the number of unique approvals across building modules, wall elements and floor elements that satisfy the requirements in NS 8175:2019.

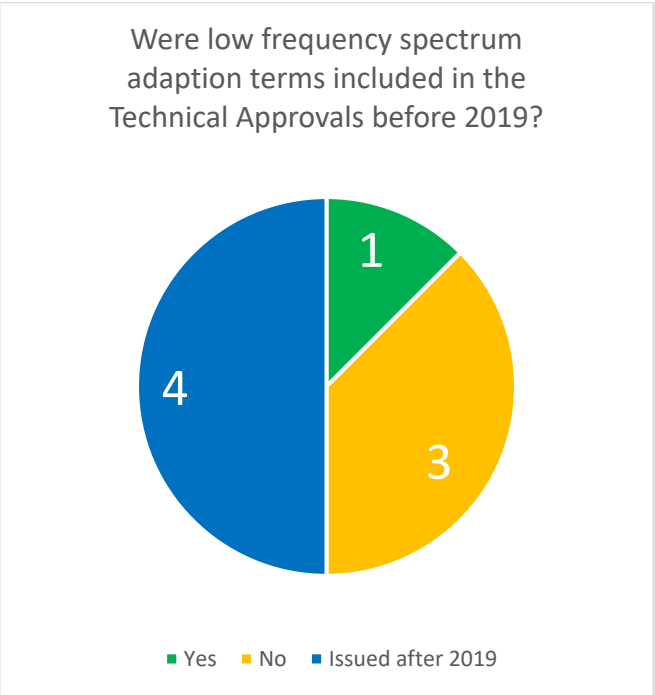

Figure 5: Half of the Technical Approvals that satisfy the requirements in NS 8175:2019 were issued after 2019

Looking at these data, it seems clear that the market is moving in the right direction following the revision of NS 8175. In addition to the product groups displayed in Figure 1, sound insulation properties are also declared in four Technical Approvals for floor heating systems, see Figure 6.

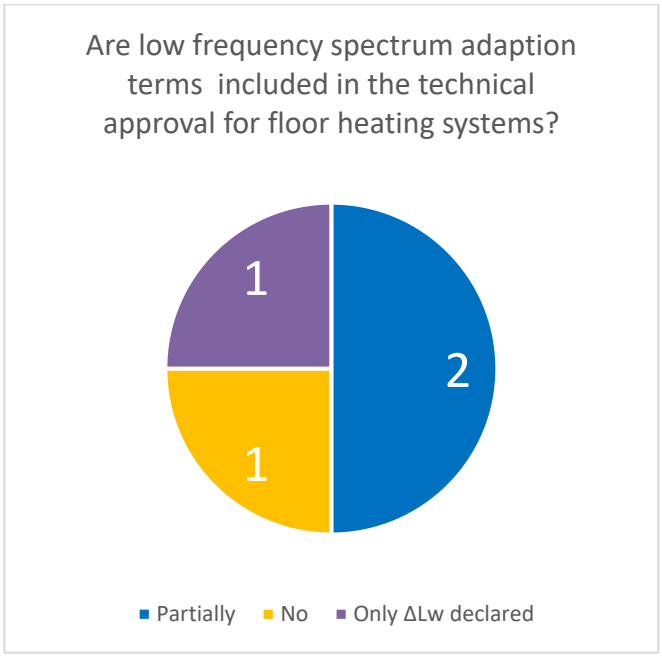

Figure 6: A graphical representation of how many Technical Approvals for floor elements have included low frequency spectrum adaption terms

Albeit with a small sample size, the numbers in Figure 6 are relatively encouraging. This also ties in with the impression from the laboratory, where clients with this kind of product seem to be more focused on the low frequency spectrum adaption terms than others.

However, the single number quantity ΔL_w is defined in ISO 717-2 [7], where the frequency range is limited downward to 100 Hz. Because the reference spectra used in calculating ΔL_w are limited to 100–3150 Hz, there exists no standardised way to perform this calculation below 100 Hz. This will in turn render any declared ΔL_w useless – at least for dwellings – when the low frequency spectrum adaption term for impact noise is adopted into legislation [8].

Summary

From SINTEF's point of view, a future implementation of NS 8175:2019 will have no dramatic impact on the Norwegian building style. Although it is more difficult to build sufficiently insulated buildings with wood compared to concrete, buildings that satisfy the coming requirements are already being built, in wood as well as in concrete. One risk might be that there will be a shift towards concrete and away from wood because concrete is easier, but there is a strong focus on sustainability in Norway, and wooden constructions are generally popular. Besides, most new apartment buildings are built in concrete as it is, and that will likely continue to be the case also in the future.

Solutions for how to build sufficient insulating buildings have been present for several years, and those solutions are

not unreasonably demanding. As Table 2 shows, the limits in the standard were also relaxed by 1 dB, which makes it slightly easier to satisfy class C in NS 8175:2019 than class C plus low frequency spectrum adaption terms in NS 8175:2012.

Despite the new standard not being part of the legislation yet, the market is already moving in the direction of which the standard is pointing. Manufacturers want to be ahead of the curve and avoid a scramble to come up with satisfying solutions once the changes do come into effect. Again, this shows that it's perfectly doable to build according to the new version of the standard. Furthermore, it implies that those who choose not to follow the new standard before they must, should have no big issues adapting their solutions to the new requirements once they come into effect.

However, the lack of possibility to calculate the single number quantity ΔL_w below 100 Hz is an issue that must be addressed. This single number quantity is widely used in marketing of floating floors or floor heating systems and is a quantity that is relatively easy to comprehend for the layman. Ideally, a way to perform such a calculation should be in place well before the new version of the standard is implemented.

References

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