Comparison of mix design methods between France and Norway and the influence of filler on asphalt performances by Mathilde Brocard, at Veidekke, supervised by Bjørn Ove Lerfald, VA génie civil

Asphalt materials are widely used around the world, especially in road construction. Mix design processes for asphalt materials consider many factors such as the available materials which are submitted to constant changes and differ from one country to another. Therefore, the mix design method is not a stated procedure being always the same but is in constant evolution and specific to each country.

In this context, what are the differences and similarities between the mix design methods of asphalt mixtures in Norway and France? Besides, to what extent and how filler material can influence the performances of asphalt material?

Types of pavements and theoretical differences between the mix design methods

Firstly, the types of pavements used in France and in Norway are not the same. These differences can be explained by different climatic conditions throughout the year, different available materials but also the use and definition of different factors such as the baring capacity or the traffic class.

The most important differences concerning the theoretical mix design methods in France and Norway are the compaction method, the contract types, and the functional requirements included in those contracts.
It can be noticed that both countries tend to deal with more contracts with functional-based requirements.

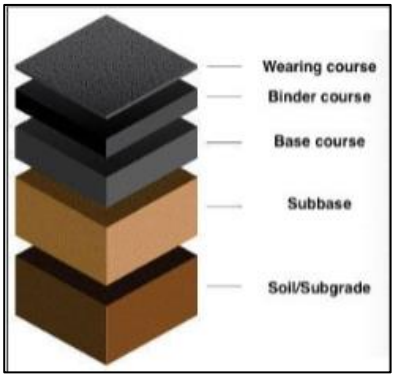

Figure 1: Sturcture of a road

	Types of pavements used in France	Types of pavements used in Norway
Asphalt gravel concrete	x	x
Asphalt concrete	x	x
Stone mastic asphalt	-	x
Soft asphalt	-	x
Mastic asphalt	(x)	(x)
Topeka	(x)	(x)
Porous asphalt	x	-
Thin asphalt	x	(x)
Asphalted gravel	x	(x)

Figure 2: Different types of pavements used in France and in Norway

	France	Norway
Compator	Gyratory	Marshall
Contracts	Specifies the type testing level	Recipe-based or based on functional requiremnts
Funcitonal requirements	Decided by the chosen type testing level (Gyratory, ITSR, Wheel-track, stiffness modulus, fatigue resistance)	Chosen in the contract (Prall, ITSR, Wheel-track)

Figure 3: Most important differences between the French and Norwegian mix design methods

Filler in the mix design

Literature has shown that the reuse of baghouse fines may have been associated with distress mechanisms such as poor compaction, bleeding and flushing, water sensitivity, cracking or rutting. Also, baghouse fines can serve either as binder extender or stiffener. Thus, baghouse fines and mineral filler play a major role in the properties and behavior of asphalt paving mixtures and it is important to understand and characterize the properties of such materials. The bitumen number test can be used to evaluate the influence of the filler material on the stiffness of the mortar phase in an asphalt mixture. Also, the Rigden voids test can give indications on the stiffness of a filler-binder mix as well as on properties like Marshall stability and flow. The Vändskak test is useful to characterize the filler material regarding water resistance. Furthermore, this test can be used to look for solutions to

improve the properties of the filler such as the adjustment of the binder content in the mix or the use of adhesion promoter. These tests have also shown that it is very difficult to characterize and analyze the properties of filler materials while also showing that it is necessary to do it in order not to compromise the performance parameters of asphalt pavements.

Comparison of the French and Norwegian mix design methods on asphalt mixtures

One common French asphalt mix (AC10-BBSG) and one common Norwegian asphalt mix (Ab11) have been produced and tested in order to compare their mix design methods.

As a conclusion, it can be noticed that the two asphalt types do not have the same initial composition, but have the same optimum binder content. Although both mixes are considerably different in terms of filler and voids contents, their Marshall properties and resistance to deformation and water were found to be approximately the same. In addition, the evaluation of these properties showed that both mixes have very good performances, fitting all the requirements given by both the French and Norwegian specifications for high traffic volumes, and even fitting the specifications for asphalt mixes usable on Norwegian airfields.

	French AC10-BBSG	Norwegian Ab11
Optimum bitumen content (%)	5,8	5,8
Filler content	3%	9%
Voids content after 80 gyrations	7,9%	3,7%
Voids content after 75 blows	5,7%	2,4%
Marshall stability (kN)	12,9	13,0
Marshall flow (mm)	3,6	3,4
Deformation after the Wheel track test (%)	2,9	2,8
ITSR Value	109	104

Figure 4: Synthesis on the different parameters evaluated

Figure 5: Gyratory compactor

Figure 6: Compacted specimen

Figure 7: Asphalt mixing

Figure 8: Marshall compactor

Figure 9: Wheel-track test

Figure10: Vändskak test