TRONDHEIM AIRPORT VÆRNES NORWAY

New 27.000 m2 apron

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SUMMARY

Trondheim Airport Værnes, Norway has been a combined military and civilian airport since 1953. To expand capacity a new passenger terminal was built, and it was decided to expand the apron area during 1993-1994. The new apron 27.000 m2 is paved with concrete paving blocks, rectangular 100 x 200 x 80 mm thick, in herringbone pattern. The new apron will be in use late 1994.
This report informs about the project.

DEVELOPMENT AT VÆRNES.

The airport has been expanded a number of times. Presently it serves a region with abt 250.000 inhabitants. The civilian traffic is abt 1.3 million passengers/year with aircraft such as B373, DC9, MD80. Occasionally larger charter planes visit Værnes. The expansion is designed to cater for 1.7 million passengers/year.

New areas for auto and bus traffic were built. The bus terminal and all roads designed for heavy traffic (7000m2) were paved with Uni-Coloc 80 mm concrete class 60 mPa, (laid by Lintho) during 1992. These areas are in perfect state after two years of service, no maintenance required, in spite of two winters with studded tires.

DESIGN OF NEW APRON

The Civil Aviation Adminstration, Oslo, had the new apron (320 x 85 metres) designed by I-consult AS Ingeniørconsult, Brekstad. The design was made for flexible pavement Asphalt concrete, with base material for paving blocks. The choice of concrete pavers was made april 1993. The main reason for the choice was the desire to have a surface which did not deform, at the lowest possible price. Other considerations were: the quicker runoff of rainwater which means a dryer, thus safer apron with less ice on the surface, Long life and low maintenance requirements. The apron was designed to take the loads of all types of civilian aircraft, even DC8.
To some extent the decision was based on the excellent results and experiences that the Civil Aviation Administration had with concrete pavers laid on aprons at Kjevik KristiansandS and Sola Stavanger airports during the previous 5 years.

The area was previously a small airplane apron, crossfall 2%. The new apron was designed with a crossfall of 1.65%, so that asphalt could be used if so decided.

Thus the material on top of the old surface would have a thickness which varied between 110 and 40 cm. Drainage may be a problem in this area where winter ground frost may be more than 2 metres deep. The strength of the ground underneath the old surface was between CBR 5 and 20.

Sub base layer: 10 to 50 cm thick layer of crushed rock on top of the old surface.

Base layer: 20 cm thick layer of 0-64 mm crushed rock, strength: class 3 or better, spread to an even layer, compacted to a level of +/- 10 mm with a maximum of +/- 15 mm.

Bedding sand: 30 mm thick (tolerance +/-10 mm) layer after compaction and screeding, of 0-8 mm crushed rock with a low content of fines (1-3% below 75 my). The bedding sand had to remain open structured to facilitate draining. (The bedding sand was not washed, so the fines content may prove to be greater than 3%?) The screeding had a tolerance of +/- 2 mm for long wave variation measured on 3 metres.

All above was to be supplied and constructed by the general contractor.

Pavers were to be 200 x 100 x 80 mm rectangular with 1.8 mm nibs on all sides and 5 mm chamfers. The reason for this size chamfer was to improve surface draining.

Tolerance limits for the pavers were: length x width+/-0.6 mm, thickness +/-1mm, and the joints were specified to be between 2-3 mm.

Jointing sand 0.5-2mm was to be spread and brushed into the joints, then vibrated with a 70 kg steel plate, then after refilling the joints it was to be vibrated with 5-700 kg steel plate 2 times to get lock up and prevent later settling.

The total area is to be sealed with a prepolymer Pavseel 2.2 m2 per litre, which is to be applied in 1994 after the area is brushed clean of sand etc and after joints are controlled.

QUALITY CONTROL, CONTROLL OF EXECUTION OF WORK AND MATERIALS.

The Civil Aviation Adminstration has engaged firms to act as quality control as follows:

The quality control of the general contractors work and supply of material (rock and bedding sand) is handled by I-Consult. The author is engaged by the CAA to control the pavers and the paving operation. This divided responsibility necessitates very good cooperation. (Comment: The quality of the apron is totally dependent upon top quality in all work operations, and great attention to the detailed specification, it is not usual for general contractros to work to such tight tolerances on the ground.)

CONSTRUCTION WORK

The general contractor Veidekke AS did the work during 1993/1994. Most of the work including the bedding sand was done during 1993.

The paver producer Vikaune Fabrikker was responsible also for the laying. To ensure proper quality, production and laying were planned in detail. The production machine has a small mould, with pavers in herringbone pattern it gave 0.46m2/stroke. i.e.60.000 strokes for the job, which is more or less the total life of the mould. To avoid tolerance problems due to mould wear, two moulds were ordered. See paper on tolerances by Haldor Grayston for comments on tolerances on this project. 0.46m2 is too small a laying unit for a large project like this. This was solved by putting two pallets together in the factory to get a laying unit of 0.92m2.

LAYING PROCEEDINGS. The total area is 85 x 320 m. To obtain effective machine laying and stay within tolerances, the area was divided into 3 parts: 320 x 30 m, 320 x 35 m, 320 x 20 m. The area prepared with bedding sand was 2 metres wider than the actual laying area to ensure correct level on the next area. The bedding sand was laid with an asphalt spreader. The bedding sand used was affected very little by rain or wind, so 5000-7000 m2 was done at the time. In the beginning a small area had to be redone, in order to meet the tolerance limits.
The pavers were laid with a Hydromak. The operators were not familiar with large areas, but after a few days the team of 3 men laid 500-600m2 per day (Laying only). 2 parts totalling 20.000m2 were done before winter came. Laying continued on frozen sand without problems, but the snow gave problems and the work stopped. Vibration could of course not be done before the sand thawed during the spring. The job will be finished May/June 1994.

JOINTING SAND Dry natural sand 0.5-2mm was brushed into the joints before vibration with a 70 kg vibrating plate. After refilling the joints, a 600 kg steel vibrating plate was run twice over the area. The steel plate did no damage to the pavers.

SEALING In May June 1994 the whole area will be sealed with a prepolymer 2.2 m2 per litre, and Pavseel is chosen.

COST

The cost of the pavement (bedding and jointing sand, pavers, sealing and work) was NOK 142.56/m2 or about GBP 13/m2.
hourly pay incl sos costs is NOK 130-140.-). Transport cost to the site is very low, the producer being local. Other prices may be on the low side: NOK 150-160 would be an acceptable price-range.

CONCLUSION

t is possible to make an ecconomical apron with concrete block pavers. However, it is a condition that specifications are clear and strict and in accordance with the best know-how available. The work and materials need to be closely supervised, work must be done to close tolerances and if specifications are not adhered to, the final product may

become unsatisfactory.

The base MUST be according to specification and the evenness within +/- 10 mm. Bedding sand should have an even gradation between 75my and 8 (or 10) mm, supplied in a 30 mm thick compacted layer. At an airport lose bedding sand is not acceptable. It must be compacted and screeded to exact level. If not, the level and evenness of the finished pavement will not be acceptable. Tolerances of the pavers are very important, we have proven at this airport that this is not a problem if it is well planned. It was easy to maintain the joint width between 2 and 3 mm, and ~~thickness~~ difference level between pavers is down to 0.5 mm. The jointing sand should be a strong natural sand <2mm with a specified LOW content of fines. The joints must be sealed, inspected yearly and refilled if necessary. The accuracy of measurement of the pavers is a condition for easy and accurate laying with high speed.

With this installation, concrete block pavers have been chosen as top surface on parts of 3 of the major Norwegian airports. Additional airfield projects for concrete block pavers are on the way.

The Civil Aviation Administration, the paver producers, the consultants and the laying contractor can be proud of having developed an economical and safer system with long life at acceptable costlevel for aprons and taxiways at Norwegian Airports.

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