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FOUNDATIONS OF LUMINAIRE SUPPORTS. THE EFFECT OF BACKFILL ON THE STRAINS IN FOUNDATIONS

This is a summary of FinnRA Report 27/1993. The study has been done in the Helsinki University of Technology.

Different lighting column foundations were compared in two different soils, crushed aggregate and fine sand. Especially different compaction methods of fill material were compared. The foundations were then loaded with a horizontal load at a height of c. 1.2 meters. In all, 24 tests were made.

Stability for break-away columns

The aim of the study was to find out what kind of compaction is needed in the soil around the foundation in order to give sufficient stability for different kinds of foundations of break-away lighting columns. It has been found that all break-away mechanisms do not perform well in soft soil.

The results can also be used to adjust calculation methods for foundations.

Quality control methods were developed, as well. Drilling may be used to evaluate backfills. There is a good relation between drilling results and horizontal loading results. Poorly compacted or too fine graded soil layers may be found by drilling.

Soils

The soils studied were:

Crushed aggregate, sieving curve shown in figure 3. It fulfills the criteria for standard soil in the American recommendation for lighting column impact tests, NCHRP 350. Moisture content was low, 2.5 per cent.

Fine sand, finer than weak soil in NCHRP 350, but not silty. Moisture content was low, 6...9 per cent.

Foundations

The foundations in the tests were:

□ Steel foundation, X-cross-section, 600 mm wide, 1900 mm deep, with no plate in the bottom. It can be pressed into the ground without digging.

Δ Concrete foundation, round cross-section, diameter 750 mm at the bottom, 430 mm at the top, 1700 mm deep.

O Wood pole, diameter 260 mm, 2000 mm deep, in one case 1700 mm deep.

● Wood pole, water used in compaction, moisture content 5 per cent.

Compaction

The compaction methods were:

0. No compaction
1. Surface compacted, only
2. Compaction in 1 m thick layers with a bucket-beam
3. " 0,5 m "
4. " 0,5 m with a 50 kg vibrator plate
5. Large stones placed around a wood pole.

A bucket-beam is piece of a log or steel pipe with a base plate with the diameter 260...400 mm. It is fixed into the bucket of a digging machine. The soil is compacted by pressing with the beam.

Results

The results from the tests are shown in figure 1 and 2. $M_{30\,mm}$ is the momentum which causes a 30 mm displacement at the top of the foundation. The momentum is the volume of the horizontal load multiplied by the height of the load, measured from the ground surface. The actual point around which the foundation starts to rotate during the loading is situated 750...1200 mm below the ground surface. The depth is smallest when the momentum $M_{30\,mm}$ is highest.

In earlier impact tests slip-base columns and weakened wood poles did not perform well in poorly compacted sand or gravel, but they did well in well compacted gravel or crushed aggregate (NCHRP 350 standard soil). For that reason the requirement for $M_{30\,mm}$ should be higher than 25 kNm but lower than 35 kNm. Here 30 kNm has been chosen as a minimum for columns not tested successfully in weak soil.

Figure 1 and 2 show that bucket-beam and vibrator plate give a compaction good enough in crushed aggregate. Results in fine sand are lower than 30 kNm, except for one concrete foundation. The momentum capacity remains very low in foundations where only the top soil only has been compacted. The foundations without any compaction in the soil gave the poorest results. The use of water as a compaction method increased the momentum capacity significantly, but still the value was below 30 kNm.

Break-away performance

In order to ensure the performance of break-away column foundations, aggregate and compaction which provide a momentum capacity 30 kNm or higher should be used. It is, however, preferable to develop new break-away columns which perform well also in soft soil, like clay, silty moraines and poorly compacted sand, which are often used in Finland. These soils give a much lower stability to the foundation than the well graded fine sand tested here and the sand used as weak soil in NCHRP 350. Almost dry poorly graded and poorly compactable sand might be used instead of sands mentioned above to simulate conditions in clay etc. in impact tests.

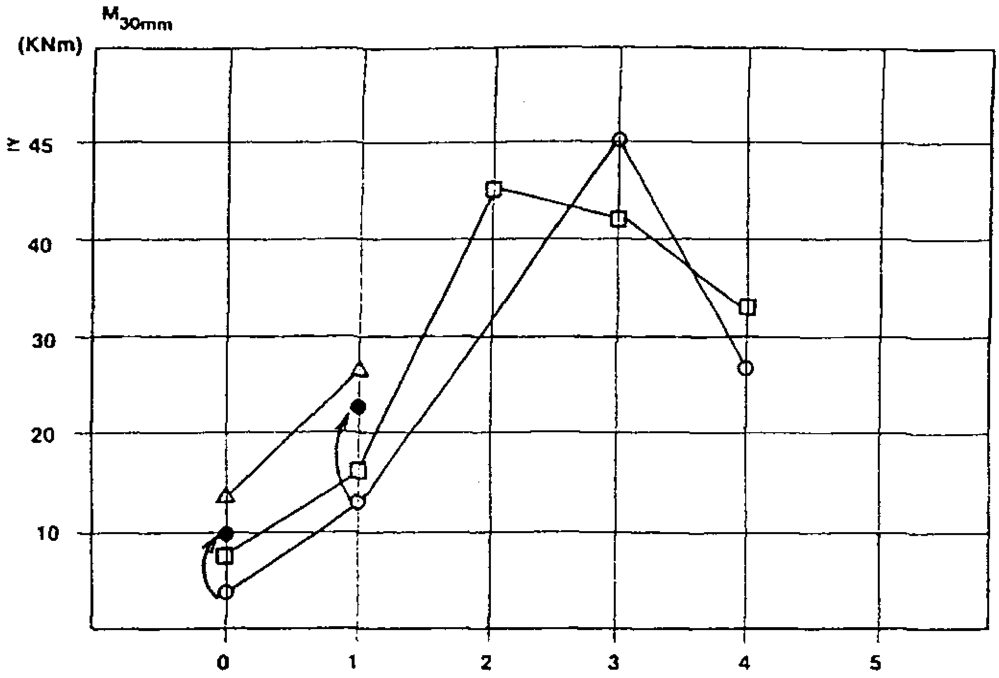

Figure 1: The relation between $M_{30\,mm}$ and compaction method in crushed aggregate. The symbols of foundation types and compaction methods are shown in the table above.

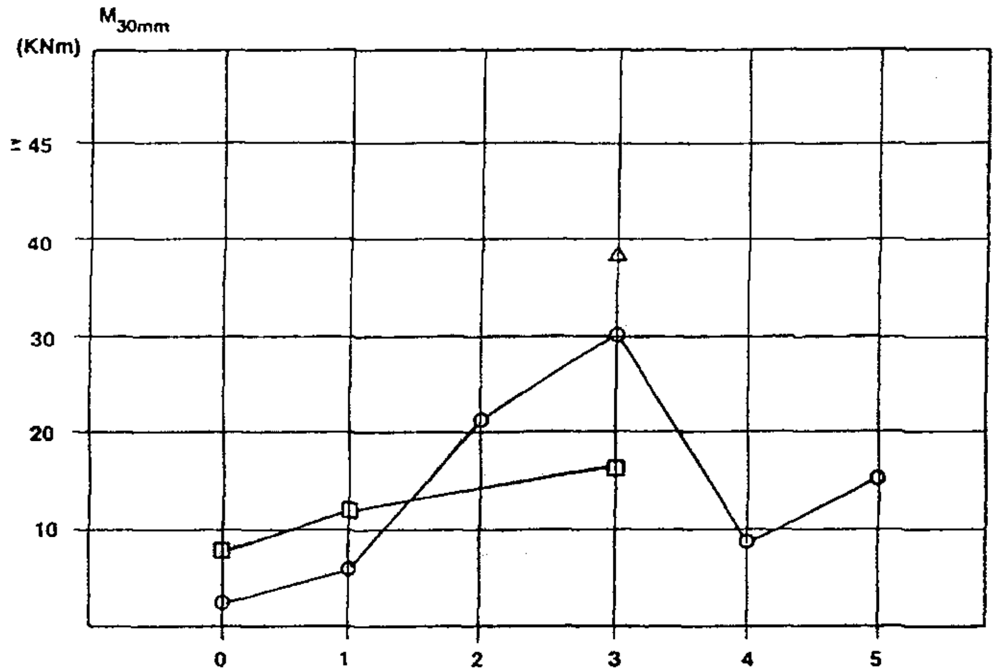

Figure 2: The relation between $M_{30\,mm}$ and compaction method in fine sand.

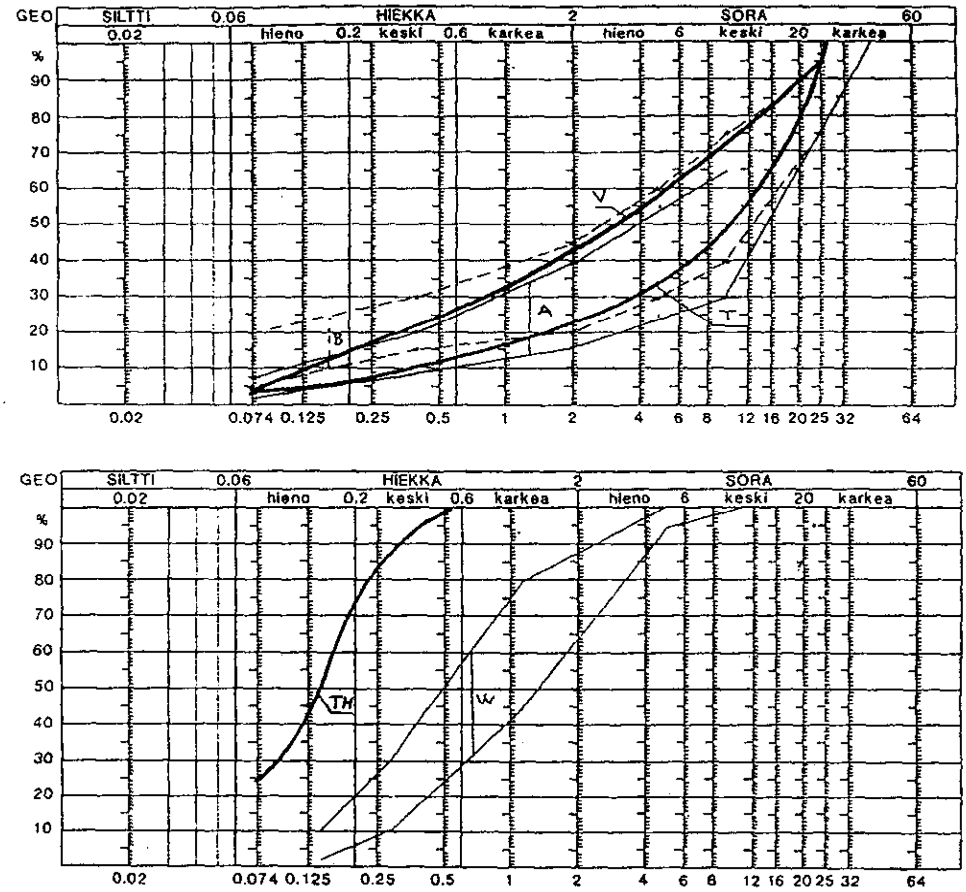

Figure 3: Sieving curves.
A and B standard soil in NCHRP 350
V aggregate used in crash tests Vierumäki
T aggregate used in the compaction study
W weak soil in NCHRP 350
TH sand used in the compaction study

FinnRa Engineering News is a newsletter for outline information on engineering developments in the Finnish National Road Administration.

Previous numbers: 1. Break-away Lighting Columns, Current Practice in Finland in 1993

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