INDUSTRIAL CONCRETE FLOOR DESIGN UNDER EXTREME CONDITIONS

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Abstract

Concrete industrial floors are thin concrete slabs, which lay on backup. They are stressed by load and volume changes. Usually they are reinforced by fibres.

Keywords: floor, soil slab, soil column

1 Introduction

By extreme conditions, subject to which industrial concrete floors are installed or laid, we mean boundary or limiting properties of the subsoil enormous load and respectively strict conditions for deformation. The properties of the subsoil have an influence on internal forces and deformation of industrial concrete floors. When executing structures we usually encounter at least a combination of two rare or exceptional conditions – poor subsoil and extreme load.

2 Subsoil

For various types of operation, the properties of the subsoil of industrial concrete floors are defined or determined by Westergaard´s modulus, which is a parameter of the surface model. It is usually mistaken for by technicians as the measured value at the highest point in the underlayer of the floor when performing the static loading test. The recommended minimum value of the modulus is 0,03N/mm3 for low-load operation such as food stores/shops/hypermarkets/supermarkets. Subsoils having properties under the said limit should be modified or treated to have an impact on the internal forces and deformation of the concrete foor. It is therefore unacceptable to have a layer of soil of soft or loose consistency in the deformation zone of subsoil (according to the czech standard ČSN 731001). A deformation zone is limited space under foundation in the subsoil where significant deformations take place. From experience the depth of the deformation zone under the wheel of a vehicle is 0,7 – 1,1m and under industrial floor it is 2,5 – 5m.

3 The load

A force of over 100KN in the leg of a rack and the load of a random grouping of machines, pallets of over 100KN/m2 can be considered as high load. We usually come across the said values in the field of storage of sheet metals, in press factories when storing

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rolls of sheet metals and when placing three rolls on one another(the weight of one roll is 10 tonnes).

4 Deformation

It is possible to consider as normal deformations, deformations for warehouses and normal storage facilities with the height of foundation of over 6m (3mm/1,2m) and for system storages with foundation height of over 6m (2mm/1,5m). It is possible to consider as exceptional or rare, the requirements for operational deformation of long automated lines as workplaces (2mm/30-40m). An entirely different problem pose dynamically loaded industrial floors with textile machines or floating automated workplaces which must show a 30% difference of system frequency from own receptor frequency and for exceeding the hygienically acceptable amplitude threshold, for which the work of women is disallowed.

5 The floor of metal press factory

The load : 200kN/m2, the stand of rack 135kN

5.1 Input parameters of subsoil

metres		
0-1	F6CL – soft quarternary	w 30% natural
1-3	F8CH – solid quarternary	w 25% natural
3-5	G2GP – firmly packed	
5-12	F8CH – firm	
12 -	F3MS – hard	

Detected water – 3 M

5.2 Treatment/Modification of floor subsoil

The floor subsoil composes of a soil – slab of thickness 0,7m of heterogeneous grain sizes 0 – 125 with granularity factor/number Cu greater than 30 and curvature number Cc in the limits 1-3. The material at the same time conforms to the requirement for the amount of the fraction upto 0,5 less than 20% and the limit of fluidity, WL < 40%.

A compaction attempt was realized after pilotage.
A static loading test inbetween the pilots by means of a slab after levelling of the site and after pressing by a roller, VV140 showed the values E1 = 10MPa and n = 2,7. The subsoil got deformed in the form of the appearance of a long wave after a manoeuvre by a vehicle before pilotage. After pilotage a reinforcing geosynthetic material GEOLON PP120 was installed on a modified subgrade and on a layer of thickness 0,2m after pressing by a roller the parameters of the layer werw E1def = 32MPa with n = 2,2. After the pilotage the deformations in the long wave survived or persisted. The underlayer of the floor after finishing rolling and after 24 hours showed parameters E1def = 61MPa and n = 2,2.

The soil columns accomplished by the technology of rip – off had a average lenght of 3m, the profile of the casing pipe was 520mm, the finishing criterion was fixed for 1100kNm per 0,25m. The columns were formed and according to the material consumption the diameter of the columns was over 800mm.
The material of columns – heterogeneous crusher – run material 0-32 with Cu>30, Cc<1;3>, d05<20%, WL<40%.
The columns correspond to material G2-G3 firmly packed and are installed in a spacing of 2,5x2,5m.

6 The calculation model

A calculation model for the system NEXX-SOILIN was created.

C o n c r e t e s l a b – concrete C25/30 for floors(with limited shrinkage) reinforced with dispersed reinforcement – by segmented fibres SW50 Krampe-Harex in an amount of 30kg/m3.
S o i l s l a b – heterogeneous crusher – run material 0-125 with a final layer of 0-32, reinforcing geosynthetic material GEOLON PP120 with a strength of 20kN at ε = 2%.
G e o l o g i c a l e n v i r o n m e n t / medium – described in 5.1. Soil columns were defined as geological areas. Internal forces in the floor slab were calculated by means of the software NEXX – SOILIN, assessment of the load – bearing capacity of the cross – section with the application of material ductility was performed for elastic – plastic area according to the recommendation of TR No34.

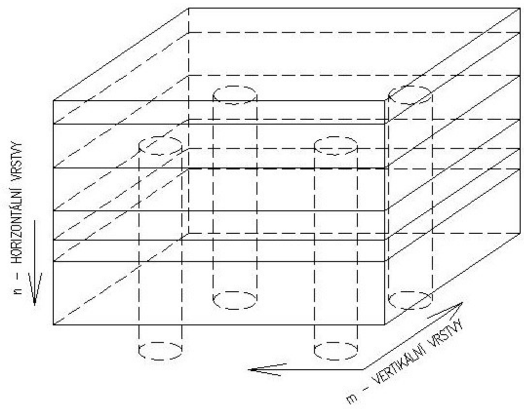

Fig. 1 Calculation model

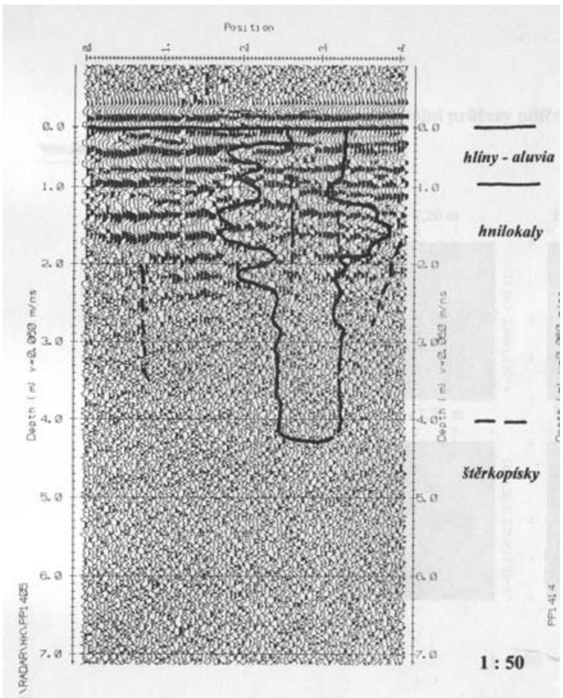

Fig. 2 The shape of the soil column

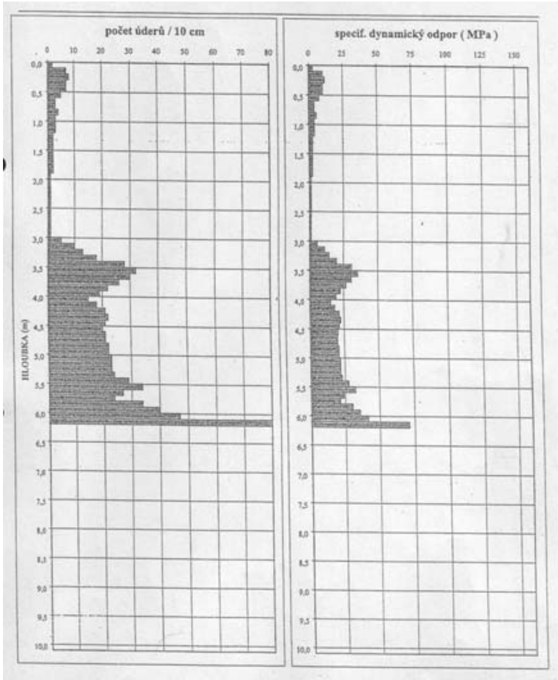

Fig. 3 Dynamic penetration:
- An example of unsuitable subsoil

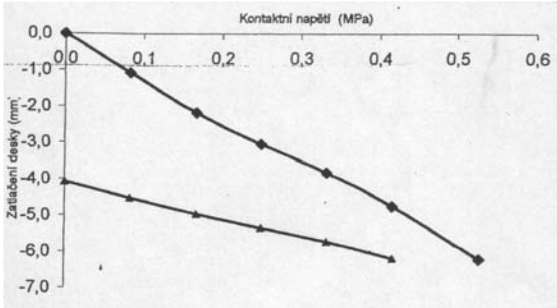

Fig. 4 Static loading test:
- an example of unsuitable loading test
(pressing and tension under floor)

References

[1] Industrial concrete floors – ČBS 2006
[2] Project documentation of the firm STAVOCONSULT of Ing. Vácha