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CORRELATION OF SOME PARAMETERS "IN SITU" DETERMINED DURING EXECUTIONS OF GHIMBAV – BRAŞOV RUNWAY AIRPORT

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Abstract: *This paper aims is to establish a correlation between two test methods made for roads, which could lead to greater efficiency in economic terms. The road structure dimentions in the art of comunications routes can be made at least by two ways based on deflectometer test with Benkelman beam, or, analytical, involving the test by the plate bearing. The two types of tests that were performed on the Ghimbav –Brasov runway airport , in the same position, on the stabilized ballast layer by 10 to 10 meters alternately on both sides of the runway to 10 meters away from the center line. Each row of test points was evaluated separately because of the execution technolog, the different time period execution and runway gradient.The best value was achieved that the best standard deviation corresponding and was found as a second-degree polynom.*

Key words: *Benkelman beam, plate bearing test.*

1. Introduction

Establishing the road structure dimentions in the art of comunications routes can be made by ways . The first variant is given by reference to an admissible value of deflection, which involves making the deflectometer test with Benkelman beam. A second variant is based on the analytical calculation of a bilayer structure, respectively the ratio of the two deformation modules from two layers which involves the establish of the linear deformation module, respectively the bed coefficient with static test by plate bearing.

The deflectometer test with the Benkelman beam above aims to determinate the bearing capacity of the structure to a specific level road and check the execution, in this case. The interpretation of results is based on empirical relations, that were based on some landmark allowable values established by a large number of test experiments.The Benkelman test was developed in the seventh decade, being currently used extensively in Europe. The method became imposed by low costs and high speed in the test execution..

An analytical dimensioning of the road structure is based on static test with bearing plate, with which can be establish the deformation of the land in relation of the applied pressure. The Reaction module, K0 is determined using this type

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of test representing the ratio of deformation module and plate diameter. The value obtained is not an intrinsec characteristic of the land, being dependent by the diameter of the plate, respectively, by the dimensions of the foundation or the element that generates the overload.

This paper aims is to establish a correlation between the two methods, which could lead to greater efficiency in economic terms. Concerns in this regard are older, starting with the establishment of the deflection by the Benkelman test. The results of the correlation in this regard led to a quite severe limitations of their applicability. It was noted that a much better correlation is imposed by various factors such as: type of structure tried (spring, half-spring, plastic), seasonal variations of temperature, by humidity or by the layers thickness of road structure.

As a result result that we present have limited applicability to the specific conditions under which the tests were conducted.

2. Tests made during exeution on stabilised ballast layer

The runway for landing and takeoff of International Airport Ghimbav-Brasov was designed as a rigid concrete structure due to good behavior on high stresses and to the increased durability compared to a semi-rigid or flexible road structure.

The runway structure consists of different structural layers as follows (from bottom up to):

- Stabilized soil (with Dorosol)
- shape layer thickness of 30 cm;
- ballast, foundation layer thickness 40cm;
- ballast stabilized, thickness 25 cm;
- concrete, thickness 41 cm

During execution several tests were performed on the runway for landing and takeoff, to determine and verify the mechanical and physical characteristics of the layers forming the structure of airport consistent with the requirements in the specifications.

The Benkelman beam is a deflection-measuring device developed in 1953 by A.C. Benkelman of the Bureau of Public Roads [1]. In operation the load truck moves ahead at a creep speed and the total pavement deflection between the dual tires as they pass the probe foot is read from the indicating dial.The test was done according CD 31-2002 romanian norm, which refers to flexible and semi-rigid road structures, also applicable and rigid concrete structures.

Deflection's road are caused by a vehicle used for testing. This should be a truck which can be loaded to the prescribed axle weight on a single rear axle with dual tires.

It is suggested that a 9-ton axle load be used. The load should be equally distributed between the two wheels, and it shold be produced by one of the rear wheels 57.5 kN double standard vehicle with a rear axle load of 115 kN [3].

Fig. 1. *Benkelman beam test*

The characteristic value of defexion is calculated with the equation:

$$d_c = d_{M20} + t_\alpha \cdot s_{20} \qquad (1)$$

Where:

d_{M20} – is the normal medium deflexion according to the measuring used technique;

s_{20} – standard deviation;

t_α – coefficient that depends on the probability of some deflexion values and to the technical class of the road

The plate bearing test was performed according to NP 034-99 (romanian standard for rigid structures airport roads designing). The plate diameter is about 750 mm. It was applied two-stage loads of 10 KPa and 70KPa, each of them maintained until settelments plast was stable (<0.05 mm / min)

Subgrade modulus of was calculated according to the formula:

$$K_0 = \frac{70}{C_1 - C_0} \cdot \frac{50}{75} \qquad (2)$$

3. Interpretation of the results

To the interpretation of results we selected data from the two types of tests that were performed in the same position on the stabilized ballast layer. The medium deflexion, tests were made by 10 to 10 meters alternately on both sides of the runway to 10 meters away from the center line.

Fig. 2. *Plate bearing test*

Results are presented on the below table :

Test results on stabised balast Table 1

distance	Position from the axis					
	Left – 10 meters		Axis		Right – 10 meters	
m	ks	bkt	ks	Bkt	ks	bkt
	[mm^{-2}]	[MPa]	[mm^{-2}]	[MPa]	[mm^{-2}]	[MPa]
0	136.36	97.73975		97.73975	-	-
60	138.16	103.8898	137.705	94.66473	137.25	85.43964
120	143.84	83.38962		82.36461	145.83	81.3396
180	140.94	97.73975	141.415	93.63972	141.89	89.53968
240	139.07	99.78977	144.005	90.56469	148.94	81.3396
300	137.25	93.63972		91.5897	141.89	89.53968
360	140.94	95.68974	143.385	97.73975	145.83	99.78977
420	140	89.53968		86.46465	136.36	83.38962

480	141.89	95.68974	140.025	94.66473	138.16	93.63972
540	137.25	79.28959		86.46465	139.07	93.63972
600	141.89	97.73975	139.125	96.71475	136.36	95.68974
660	140.94	91.5897	142.39	96.71475	143.84	101.8398
720	136.36	87.48966		81.3396	139.07	75.18955
780	144.83	85.43964	140.155	92.61471	135.48	99.78977
840	146.85	95.68974	144.855	88.51467	142.86	81.3396
900	145.83	93.63972	144.835	89.53968	143.84	85.43964
960	143.84	91.5897	145.865	94.66473	147.89	97.73975
1020	142.86	89.53968	145.9	94.66473	148.94	99.78977
1080	145.83	105.9398		104.9148	146.85	103.8898
1140	144.83	87.48966		85.43964	147.89	83.38962
1200	138.16	99.78977	142.505	95.68974	146.85	91.5897
1260	141.89	83.38962		90.56469	136.36	97.73975
1320	147.89	83.38962	146.36	94.66473	144.83	105.9398
1380	139.07	87.48966		85.43964	148.94	83.38962
1440	144.83	101.8398	141.495	100.8148	138.16	99.78977
1500	145.83	89.53968		89.53968	142.86	89.53968
1560	136.36	99.78977		89.53968	148.94	79.28959
1620	138.16	97.73975		88.51467	148.94	79.28959
1680	139.07	81.3396		84.41463	137.25	87.48966
1740	140.94	87.48966	140.47	93.63972	140	99.78977
1800	138.16	93.63972	140.51	92.61471	142.86	91.5897
1860	143.84	89.53968		85.43964	141.89	81.3396
1920	142.86	95.68974	145.9	91.5897	148.94	87.48966
1980	154.41	81.3396	150.12	90.56469	145.83	99.78977
2040	151.08	93.63972	147.955	91.5897	144.83	89.53968
2100	141.89	97.73975	143.86	98.76476	145.83	99.78977
2160	143.84	97.73975	143.35	97.73975	142.86	97.73975
2220	144.83	97.73975		97.73975	145.83	97.73975
2280	145.83	89.53968	147.385	91.5897	148.94	93.63972
2340	151.08	87.48966	148.965	90.56469	146.85	93.63972
2400	147.89	95.68974	146.86	97.73975	145.83	99.78977
2460	146.85	99.78977		96.71475	150	93.63972
2520	152.17	89.53968		94.66473	151.08	99.78977

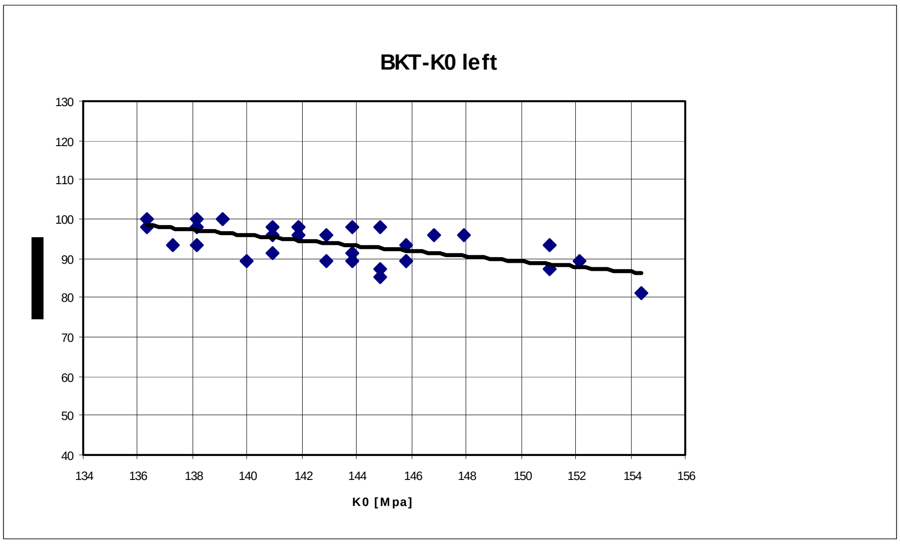

Fig. 3. *Left side results (delexions vs. subgrade modulus)*

$$y = 0.0007x2 - 0.8596x + 203.5$$

$$R2 = 0.441$$

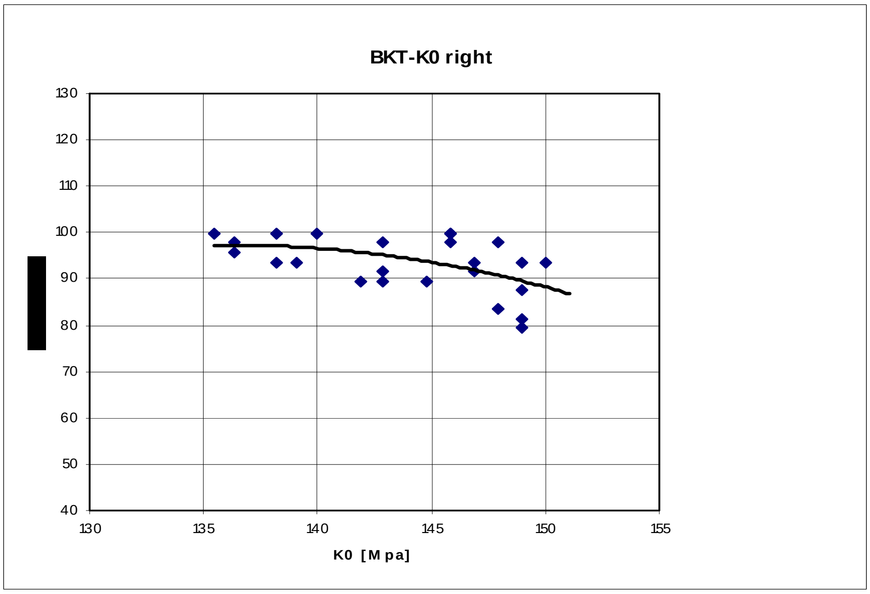

Fig.4 . *Right side results (delexions vs. subgrade modulus)*

$$y = -0.0474 \cdot x^2 + 12.918 \cdot x - 782.39$$

$$R^2 = 0.2323$$

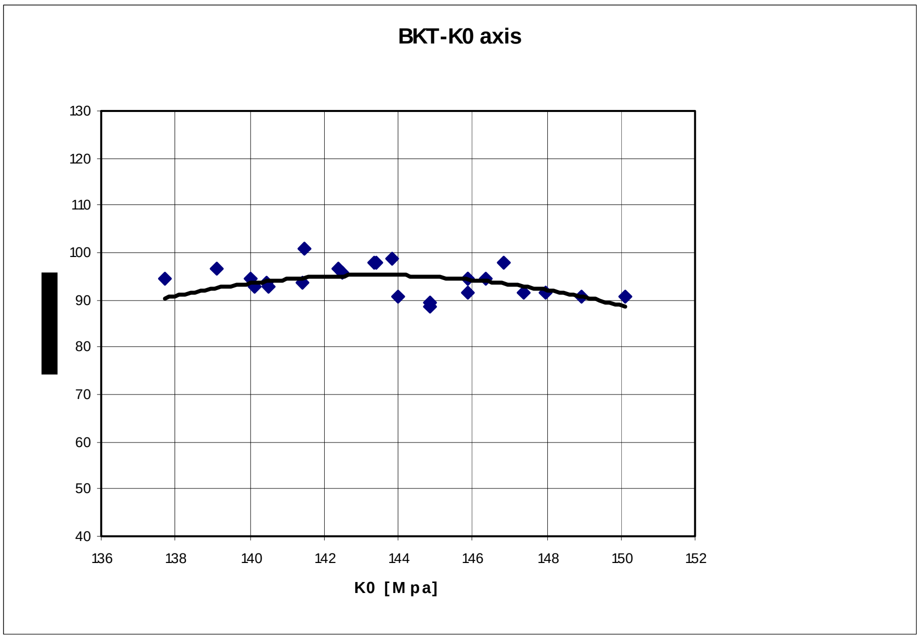

Fig. 5. *Axis results (deflexions vs. subgrade modulus)*

$$y = -0.1476 \cdot x^2 + 42.345 \cdot x - 2941.1$$

$$R^2 = 0.169$$

4 Conclusions

Values were statistically interepreted elimiating those values that are depassing 20% of the mean value, as being gross errors.

For each of the three sets of values were determined trendline equation separately. The best value was achieved that the best standard deviation corresponding and was found as a second-degree polynom. We was considered that each row of test points must be evaluated separately because of the execution technology, the different time period execution and runway gradient.

The average of the three equations is:

$$y = -0.0648 \cdot x^2 + 18.1347 \cdot x - 1173.33 \quad (4)$$

References

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3. *** CD 31-2001: *Normativ pentru determinarea prin deflectografie şi deflectometrie a capacităţii portante a drumurilor cu structuri rutiere suple şi semirigide cu deflectograful Lacroix şi deflectometru cu pârghie Benkelman..*