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ANALYSIS OF SCHOOL CHAIRS DIMENSIONS IN PRIMARY SCHOOLS IN THE MUNICIPALITY OF AERODROM – SKOPJE

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ABSTRACT

Educational institutions are facilities where each person spends many years of their lives. Chairs used in these institutions are designed with specific features of shape, material and size. Long-term use of chairs in educational institutions may be the cause of damage to the health of consumers if the chairs are not carefully designed and dimensioned.

Compliance with the prescribed rules and dimensions in the design of school chairs is of great importance for the proper development of the users that are in the phase of growth and development, when using this type of chars.

In this paper functional dimensions of real samples of chairs taken from primary schools in the Municipality of Aerodrom – Skopje will be measured. The testing samples of chairs will be designated to the group that they belong to according to the EN 1729-1:2006 standard, and all requested dimensions according to the standard will be measured.

The purpose of this work is to show the real state of school chairs in elementary schools and whether the chairs are with the requested dimensions of the EN 1729-1:2006 standard.

Keywords: elementary school, school furniture, school chair, school desk, anthropometry of children, physical development.

1. INTRODUCTION

Long-term use of office furniture in educational institutions could be the reason for health worsening of its users if it is not meticulously dimensioned and designed. In order to avoid such issues, functional measures of the furniture for sitting and working while using school furniture are prescribed in EN 1729-1:2006 standard, while safety conditions that have to meet the satisfactory needs of school furniture for sitting and working are prescribed in EN 1729-2:2006.

Whether the required standards of school furniture used in schools are observed and to what extent is it, shall be the research of this paper seen through real samples that are found in primary schools on the territory of the municipality of Aerodrom, Skopje, Republic of North Macedonia.

The research shall be done only for the primary schools because the users who use the chairs are at the age of 5.5 to 14, i.e. in the stage of life when human body develops the most and drastically changes its height and shape.

The choice of the municipality of Aerodrom is done for the reason that this is the most inhabited municipality as a territory in the city of Skopje. In its territory of 20 km^2, 10.4 m^2 are taken as an urban part. In the urban area, there are 8 primary schools in which 6 000 students annually go to school.

The carefully designed and elaborated furniture would contribute to a healthier and physically good-looking youth, as well as a better working atmosphere during the school day.

2. MATERIALS AND METHODS

During the visit to the primary schools on the territory of the municipality of Aerodrom, measures of 7 different types of chairs were taken. In terms of what for and by children of which age the chairs are used, only one sample is used by first grade school schildren, whereas the other samples are used in all other grades, from the second to the ninth grade. For measuring the samples, they were marked with numbers, from sample 1 to sample 7. The results of measuring the dimensions will be compared to the dimensions required according to the standard.

According to the design, appearance and state in which chairs were found, it can be assumed they were purchased at different times in the past. In older schools there are many different types of chairs, while in the newly built schools, such as the elementary school Aleksandar Makedonski built in 2013 all the chairs there are identical.

The collected 7 different samples of chairs were taken to the laboratory and all measuring procedures required by standard EN 1729-1: 2006 were performed. The obtained results of the measurements were compared with the prescribed range of permissible dimensions.

According to EN 1729-1:2006 standard for chairs, as well as the height of the chair, it is estimated which group the chair belongs to. According to the group it is necessary to first meet the other required dimensions. The measurement was made with an accuracy category II rule and with a digital protractor.

Table 1. *Dimensions and size marks for chair - EN 1729-1:2006*

Size mark	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Color cod	□	■	■	■	■	■	■	■
Popliteal range (without shoes)	200-250	250-280	280-315	315-355	355-405	405-435	435-485	485+
Stature range (without shoes)	800-950	930-1160	1080-1210	1190-1420	1330-1590	1460-1765	1590-1880	1740-2070
h_8- height of seat ±10	210	260	310	350	380	430	460	510
t_4-effectuve depth of seat ±10 (0-2) ±20 (3-7)	225	250	270	300	340	380	420	460
b_3- seat width min	210	240	280	320	340	360	380	400
t_7-depth of seat min	t_4 - 20m	t_4 - 20m	t_4 - 20m	t_4 - 30m	t_4 - 30m	t_4 - 30m	t_4 - 30m	t_4 - 30m
h_6- height of the foremost point of the backrest (point S) -10mm +20mm	140	150	160	180	190	200	210	220
h_7- backrest height min	100	100	100	100	100	100	100	100
b_4-width of the backrest min	-	210	250	270	270	300	330	360
r_2-horizontal radius of the backrest min	-	300	300	300	300	300	300	300
β-inclination of the backrest	-	95^0-110^0	95^0-110^0	95^0-110^0	95^0-110^0	95^0-110^0	95^0-110^0	95^0-110^0

3. RESULTS

The measured results will be shown separately for each tested sample.

3.1. Sample 1

The sample is a chair used in the first grade.

Figure 1. *Photos of the measurement of sample 1*

Table 2. *Dimensions (sample 1)*

Required dimension	Measured dimension	Referent values for height group 2 (violet)	Values met √ Values not met X
h_8- height of seat ±10	325 mm	310 mm	X (+5 mm)
t_4-effectuve depth of seat ±10 (0-2) ±20 (3-7)	365 mm	270 mm	X (+85 mm)
b_3- seat width min	330 mm	280 mm	√
t_7-depth of seat min	320 mm	t4-20 mm	X (-25 mm)
h_6- height of the foremost point of the backrest (point S) -10mm +20mm	160 mm	160 mm	√
h_7- backrest height min	172 mm	100 mm	√
b_4-width of the backrest min	350 mm	250 mm	√
r_2-horizontal radius of the backrest min	355 mm	300 mm	√
β-inclination of the backrest	103,2° mm	95°-110°	√

3.2.Sample 2

The sample is a chair used for first grade pupils.

Figure 2. *Photos of the measurement of sample 2*

Table 3. *Dimensions (sample 2)*

Required dimension	Measured dimension	Referent values for height group 3 (yellow)	Values met √ Values not met X
h_8- height of seat ±10	360 mm	350 mm	√
t_4-effectuve depth of seat ±10 (0-2) ±20 (3-7)	350 mm	300 mm	X (+30 mm)
b_3- seat width min	300 mm	320 mm	√
t_7-depth of seat min	310 mm	t4-30 mm	X (-20 mm)
h_6- height of the foremost point of the backrest (point S) -10mm +20mm	166 mm	180 mm	X (-4 mm)
h_7- backrest height min	145 mm	100 mm	√
b_4-width of the backrest min	300 mm	270 mm	√
r_2-horizontal radius of the backrest min	310 mm	300 mm	√
β-inclination of the backrest	95,2° mm	95°-110°	√

3.3. Sample 3

The sample is a desk used from the second to the ninth grade.

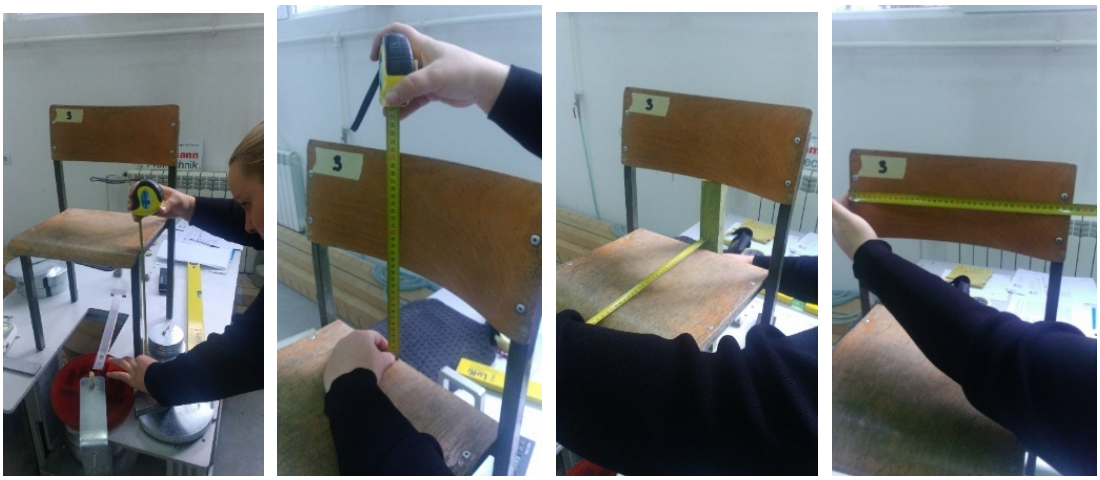

Figure 3. *Photos of the measurement of sample 3*

Table 4. *Dimensions (sample 3)*

Required dimension	Measured dimension	Referent values for height group 4 (red)	Values met √ Values not met X
h_8- height of seat ±10	370 mm	380 mm	√
t_4-effectuve depth of seat ±10 (0-2) ±20 (3-7)	350 mm	340 mm	√
b_3- seat width min	330 mm	340 mm	X (-10 mm)
t_7-depth of seat min	330 mm	t4-30 mm	√
h_6- height of the foremost point of the backrest (point S) -10mm +20mm	150 mm	190 mm	X (-30 mm)
h_7- backrest height min	155 mm	100 mm	√
b_4-width of the backrest min	320 mm	270 mm	√
r_2-horizontal radius of the backrest min	370 mm	300 mm	√
β-inclination of the backrest	98,4° mm	95°-110°	√

3.4. Sample 4

The sample is a desk used from the second to the ninth grade.

Figure 4. *Photos of the measurement of sample 4*

Table 5. *Dimensions (sample 4)*

Required dimension	Measured dimension	Referent values for height group 4 (red)	Values met √ Values not met X
h_8- height of seat ±10	375 mm	380 mm	√
t_4-effectuve depth of seat ±10 (0-2) ±20 (3-7)	410 mm	340 mm	X (+50 mm)
b_3- seat width min	370 mm	340 mm	√
t_7-depth of seat min	370 mm	t4-30 mm	√
h_6- height of the foremost point of the backrest (point S) -10mm +20mm	120 mm	190 mm	X (-60 mm)
h_7- backrest height min	175 mm	100 mm	√
b_4-width of the backrest min	385 mm	270 mm	√
r_2-horizontal radius of the backrest min	375 mm	300 mm	√
β-inclination of the backrest	98,5° mm	95°-110°	√

3.5. Sample 5

The sample is a desk used from the second to the ninth grade.

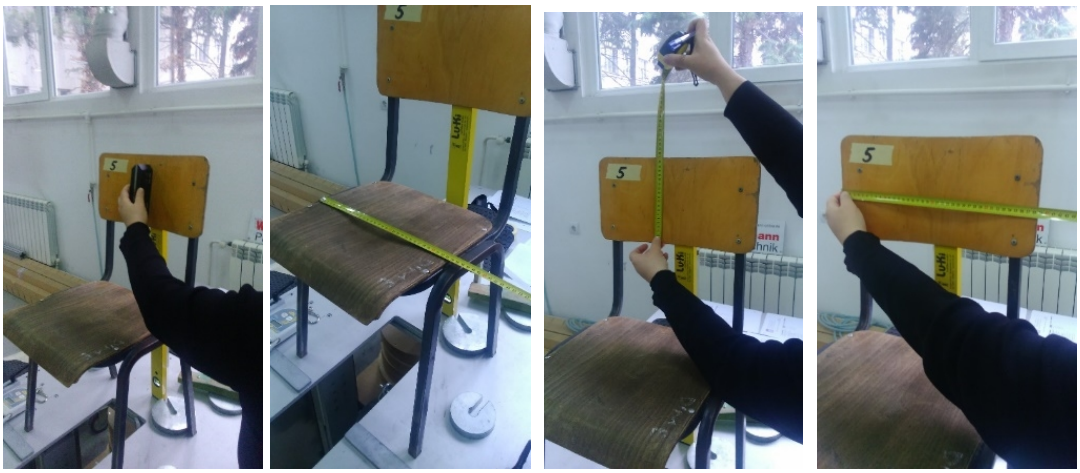

Figure 5. *Photos of the measurement of sample 5*

Table 6. *Dimensions (sample 5)*

Required dimension	Measured dimension	Referent values for height group 4 (red)	Values met √ Values not met X
h_8- height of seat ±10	405 mm	380 mm	X (+15 mm)
t_4-effectuve depth of seat ±10 (0-2) ±20 (3-7)	420 mm	340 mm	X (+50 mm)
b_3- seat width min	335 mm	340 mm	X (-5 mm)
t_7-depth of seat min	355 mm	t4-30 mm	X (-35 mm)
h_6- height of the foremost point of the backrest (point S) -10mm +20mm	190 mm	190 mm	√
h_7- backrest height min	200 mm	100 mm	√
b_4-width of the backrest min	385 mm	270 mm	√
r_2-horizontal radius of the backrest min	390 mm	300 mm	√
β-inclination of the backrest	96,4° mm	95°-110°	√

3.6. Sample 6

The sample is a desk used from the second to the ninth grade.

Figure 6. *Photos of the measurement of sample 6*

Table 7. *Dimensions (sample 6)*

Required dimension	Measured dimension	Referent values for height group 5 (green)	Values met √ Values not met X
h_8- height of seat ±10	445 mm	430 mm	X (+5 mm)
t_4-effectuve depth of seat ±10 (0-2) ±20 (3-7)	435 mm	360 mm	X (+55 mm)
b_3- seat width min	370 mm	340 mm	√
t_7-depth of seat min	370 mm	t4-30 mm	X (-35 mm)
h_6- height of the foremost point of the backrest (point S) -10mm +20mm	150 mm	200 mm	X (-40 mm)
h_7- backrest height min	175 mm	100 mm	√
b_4-width of the backrest min	385 mm	300 mm	√
r_2-horizontal radius of the backrest min	390 mm	300 mm	√
β-inclination of the backrest	105,3° mm	95°-110°	√

3.7. Sample 7

The sample is a desk used from the second to the ninth grade.

Figure 7. *Photos of the measurement of sample 7*

Table 8. *Dimensions (sample 7)*

Required dimension	Measured dimension	Referent values for height group 6 (blue)	Values met √ Values not met X
h_8- height of seat ±10	460 mm	460 mm	√
t_4-effectuve depth of seat ±10 (0-2) ±20 (3-7)	430 mm	420 mm	√
b_3- seat width min	415 mm	380 mm	√
t_7-depth of seat min	410 mm	t4-30 mm	√
h_6- height of the foremost point of the backrest (point S) -10mm +20mm	220 mm	210 mm	√
h_7- backrest height min	190 mm	100 mm	√
b_4-width of the backrest min	440 mm	330 mm	√
r_2-horizontal radius of the backrest min	390 mm	300 mm	√
β-inclination of the backrest	96,3° mm	95°-110°	√

4. CONCLUSION

Based on the results obtained, the conclusion was that none of the taken different samples of chairs thoroughly meets the required dimensions listed in EN 1729-1:2006 standard. All the measured samples had deviations from the prescribed dimensions.

Only sample 7 met all the dimensions required by standard EN 1729-1: 2006, but this sample is group 6 (blue), which, according to the standard, is intended for users with a height of 1590-1880 cm. This height group of chairs is suitable for high school students because in primary schools there are only few users with this height.

The biggest problem with the measured types of chairs was the effective seating depth and the height of the lumbar support. These particular deviations from the prescribed dimensions are the reason for the discomfort of school chairs when used long-term..

REFERENCES

[1] Bralic, I. (2017), Sekularne promene rasta i razvoja. Pediatr Croat, 52, 25-35.

[2] Mehanovic, M. (2017), Istraživanje prilagođenosti sjedišta školske stolice antropometrijskim veličinama učenika osnovnih škola. 11th International Scientific Conference on Production Engineering DEVELOPMENT AND MODERNIZATION OF PRODUCTION.

[3] Mehanović, M. (2013) Utjecaj antropometrijskih karakteristika i položaja sjedišta školske stolice na opterećenje kralješnice učenika, Proceedings of 5th International Ergonomics Conference, Ergonomics 2013. , Zadar, Croatian Society Of Ergonomics, Zagreb, Croatia, 263-270.

[4] Panero, J., Zelnik, M., (1990), Antropološke mere i enterijer, Zbirka preporuka za standarde u projektovanju, IRO Građevinska knjiga, Beograd.

[5] Domljan, D. ; Grbac, I.; Bogner, A. (2004), Uloga dizajna u procesu razvoja školskog namještaja. Drvna industrija 55(2):77-90.