Analysis of the dimensions of desks in primary schools in Aerodrom Municipality - Skopje

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Abstract. Educational institutions are facilities where each person spends many years of their life. Desks used in these institutions are designed with specific features of shape, material and size. Long-term use of desks in educational institutions may be the cause of damage to the health of users if they are not carefully designed and dimensioned. In compliance with the prescribed rules and dimensions in the design of desks it is of great importance for proper development of the users that are in the stage of growth and development when using this type of desk. In this paper, the functional dimensions of real samples of desks taken from primary schools in the Municipality of Aerodrom – Skopje will be measured. The testing samples of desks 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 condition of desks in primary schools and whether the desks are with the requested dimensions of the EN 1729-1:2006 standard.

1. Introduction

The long-term use of office furniture in the 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, the functional measures of the furniture for sitting and working while using the school furniture are prescribed in the EN 1729-1:2006 standard, while the safety conditions that have to meet the satisfactory needs of the school furniture for sitting and working are prescribed in EN 1729-2:2006.

Are the required standards of the school furniture used in the schools respected and to what extent shall be the research of this paper seen through real samples that are found in the primary schools on the territory of the municipality of Aerodrom, Skopje, R. of Macedonia.

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

The choice of the municipality of Aerodrom is done for the reason of this being the most inhabited municipality as a territory in the city of Skopje. In its territory of 20 km2, 10.4 m2 are taken as an urban part. In the urban area, there are 8 primary schools in which 6 000 students annually go to school.

During the visit of the primary schools on the territory of the municipality of Aerodrom measures of 5 different types of desks were taken. In terms of what for and on what age of children the desks are used, only one sample is used in first grade, whereas the rest are used in all the other grades from second till ninth. For measuring the samples, the same are numerated from sample 1 to sample 5. The results of
the dimensions from the measurement will be compared to the required dimensions according to the standard.

2. Analysis of the THE EN 1729-1:2006 Standard - Furniture – Chairs and desks for educational institutions – Part 1: Functional dimensions

The freedom in creating and making of school furniture is limited by some optimal dimensions, proper stability and the minimum required sustainability which should meet the needs of the school furniture before it is sent for usage. The optimal dimensions that should satisfy the school furniture for sitting and working are prescribed in EN 1729-1:2006 standard. On behalf of this research paper, the requirements of the standard in the part of the desks will be analysed.

In this part of the standard, there are the optimal and compulsory measures which the school furniture for sitting and working has to satisfy for unconditional process of the work and prevention of negative influence towards the growth and development of the final users of this type of furniture.

2.1. Required dimensions for desks according to EN 1729-1:2006 Furniture – Chairs and desks for educational institutions – Part 1: Functional dimensions

The height groups according to which the desks are divided are 8, starting from group 0 to group 7. Every height group despite the numerical designation, is also marked with different colour, so the symbolizing is as follows: (0 group – white colour, 1 group – orange colour, 2 group – violet colour, 3 group – yellow colour, 4 group – green colour, 5 group – green colour, 6 group – blue colour, 7 group - brown colour).

According to EN 1729-1:2006 standard for desks as well as the height of the working surface it is estimated in which group the desk belongs to. According to the group it is necessary to first satisfy the other required dimensions.

- $h_1$ – height of table top
- $t_1$ – depth of table top
- $w_1$ – width of top, per person at front edge where students sit
- Horizontal distance between front, legs/structure, where students sit, per person (min)

Despite these dimensions, the standard requires dimensions for desks which are used for chairs, where the sitting surface is double rounded. For this type of desks there is also a legroom which for each group is given with minimal dimension.

Since the samples found and taken for measurement are not of this type of desks, these dimensions shall not be analysed at all.

The measured dimensions of the samples will be compared to the allowed range of dimensions which the standard gives specially for each height group of desks.

Despite these dimensions, the desks should satisfy the minimum free legroom as well. This space in the standard is given as a shape with 4 dimensions which limits the space where there must not be any burden that would cause troubles while sitting.

![Figure 1. Legroom template](image-url)
After determining the basic required dimensions that the desks should satisfy, we move onto measuring the free legroom, and for this type of measurement there are special schemes for each height group separately. The schemes are elaborated according to the required measures for free space which is prescribed by EN 1729-1:2006 standard. The borders of this space are different for each height group and they are presented in Table 2.

### Table 2. Minimum legroom template dimensions

| Size mark | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|-----------|---|---|---|---|---|---|---|---|
| **Color cod** | □ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| **Popliteal range (cm)** (without shoes) | 200-250 | 250-280 | 280-315 | 315-355 | 355-405 | 405-435 | 435-485 | 485+ |
| **Stature range (cm)** (without shoes) | 800-950 | 930-1160 | 1080-1210 | 1190-1420 | 1330-1590 | 1460-1765 | 1590-1880 | 1740-2070 |
| **h2 (mm)** | 325 | 380 | 440 | 495 | 545 | 610 | 665 | 725 |
| **h4 (mm)** | 275 | 325 | 375 | 420 | 465 | 520 | 565 | 620 |
| **t2 (mm)** | 300 | 300 | 300 | 300 | 400 | 400 | 400 | 400 |
| **t3 (mm)** | 400 | 400 | 400 | 400 | 500 | 500 | 500 | 500 |

### 3. Results
The measured results will be shown separately for each tested sample.
3.1. Sample 1
The sample is a desk used in first grade. Its purpose is for 4 persons sitting simultaneously.

Figure 2. Sample 1

| Table 3. Basic dimensions (sample1) |
|-------------------------------------|
| **Required dimension** | **Measured dimension** | **Referent values for height group (violet)** | **Satisfy** | **Do not satisfy** |
| h₁ - height of top ±10 | 520mm | 530mm | √ | X |
| t₁ - depth of top (min) | 1000mm (for two persons) | 500mm | √ |
| w₁ - width of top, per person at front edge, where students sit (min) | 1000mm (for two persons) | 600mm | X |
| Horizontal distance between front legs/structure, where students sit, per person (min) | 855mm | 500mm | √ |

| Table 4. Minimum legroom (sample 1) |
|-------------------------------------|
| **Required dimension** | **Measured dimension** | **Referent values for height group (violet)** | **Satisfy** | **Do not satisfy** |
| Min. h₂ | 855 mm | 440mm | √ |
| Min. h₄ | 855 mm | 375mm | √ |
| Min. t₂ | 855 mm | 300mm | √ |
| Min. t₃ | 855 mm | 400mm | √ |
3.2. Sample 2

The sample is a desk used from second to ninth grade. It is meant for two persons simultaneously.

Table 5. Basic dimensions (sample 2)

| Required dimension | Measured dimension | Referent values for height group | Satisfy | X
|--------------------|--------------------|---------------------------------|---------|---
|                  |                    | 4(red)                          |         |  
| h₁ – height of top ±10 | 670mm              | 640mm                           | X (+20 mm) |  
| t₁ – depth of top (min) | 500mm              | 500mm                           | √         |  
| w₁ – width of top, per person at front edge, where students sit (min) | 800-600mm           | 600mm                           | √         |  
| Horizontal distance between front legs/structure, where students sit, per person (min) | 700mm               | 500mm                           | √         |  

Figure 3. Photos of the measurement of sample 1

Figure 4. Sample 2
Table 6. Minimal legroom (sample 2)

| Required dimension | Measured dimension | Referent values for height group 4(red) | Satisfy | Do not satisfy |
|--------------------|--------------------|----------------------------------------|---------|---------------|
| Min. h2            | 510 mm             | 545 mm                                 | X       |               |
| Min. h4            | 510 mm             | 465 mm                                 | √       |               |
| Min. t2            | 420 mm             | 400 mm                                 | √       |               |
| Min. t3            | 440 mm             | 500 mm                                 | X       |               |

Figure 5. Photos of the measurement of sample 2

3.3. Sample 3
The sample is a desk used from second to ninth grade. It is meant for two persons simultaneously.

Figure 6. Sample 3
Table 7. Basic dimensions (sample 3)

| Required dimension | Measured dimension | Referent values for height group 4(red) | Satisfy | Do not satisfy |
|--------------------|--------------------|----------------------------------------|---------|---------------|
| h1 - height of top ±10 | 670mm | 640mm | X (+20 mm) |
| t1 - depth of top (min) | 500mm | 500mm | ✓ |
| w1 – width of top, per person at front edge, where students sit (min) | 1300mm (for two persons) | 600mm | ✓ |
| Horizontal distance between front legs/structure, where students sit, per person (min) | 1230mm (for two persons) | 500mm | ✓ |

Table 8. Minimal legroom (sample 3)

| Required dimension | Measured dimension | Referent values for height group 4(red) | Satisfy | Do not satisfy |
|--------------------|--------------------|----------------------------------------|---------|---------------|
| Min. h2 | 630 mm | 545mm | ✓ |
| Min. h4 | 460 mm | 465mm | X |
| Min. t2 | 200 mm | 400mm | X |
| Min. t3 | 450 mm | 500mm | X |

Figure 7. Photos of the measurement of sample 3

3.4. Sample 4
The sample is a desk used from second to ninth grade. It is meant for two persons simultaneously.

Figure 8. Sample 4
### Table 9. Basic dimensions (sample 4)

| Required dimension | Measured dimension | Referent values for height group 5 (green) | Satisfy | Do not satisfy |
|--------------------|--------------------|---------------------------------------------|---------|---------------|
| **h**₁ - height of top ±10 | 720mm | 710mm | ✓ |          |
| **t**₁ - depth of top (min) | 475mm | 500mm | ✓ |          |
| w₁ – width of top, per person at front edge, where students sit (min) | 1200mm (for two persons) | 600mm | ✓ |          |
| Horizontal distance between front legs/structure, where students sit, per person (min) | 1090mm (for two persons) | 500mm | ✓ |          |

### Table 10. Minimal legroom (sample 4)

| Required dimension | Measured dimension | Referent values for height group 5 (green) | Satisfy | Do not satisfy |
|--------------------|--------------------|---------------------------------------------|---------|---------------|
| Min. h₂ | 690mm | 610mm | ✓ |          |
| Min. h₄ | 490mm | 520mm | X |          |
| Min. t₂ | 100mm | 400mm | X |          |
| Min. t₃ | 400mm | 500mm | X |          |

**Figure 9.** Photos of the measurement of sample 4

3.5. **Sample 5**

The sample is a desk used from second to ninth grade. It is meant for two persons simultaneously.

**Figure 10.** Sample 5
Table 11. Basic dimensions (sample 5)

| Required dimension | Measured dimension | Referent values for height group 6 (blue) | Satisfy | Do not satisfy |
|--------------------|--------------------|------------------------------------------|---------|---------------|
| $h_1$ – height of top ±10 | 760mm | 760mm | √ | X |
| $t_1$ – depth of top (min) | 640mm | 500mm | √ | |
| $w_1$ – width of top, per person at front edge, where students sit (min) | 1360mm (for two persons) | 600mm | √ | |
| Horizontal distance between front legs/structure, where students sit, per person (min) | 1260mm (for two persons) | 500mm | √ | |

Table 12. Minimal space for legs (sample 5)

| Required dimension | Measured dimension | Referent values for height group 6 (blue) | Satisfy | Do not satisfy |
|--------------------|--------------------|------------------------------------------|---------|---------------|
| Min. $h_2$ | 745mm | 665mm | √ | |
| Min. $h_4$ | 560mm | 565mm | √ | |
| Min. $t_2$ | 150mm | 400mm | X | |
| Min. $t_3$ | 360mm | 500mm | X | |

Figure 11. Photos of the measurement of sample 5
4. Conclusion
In accordance with the gained results, the conclusion is that none of the taken different samples of desks thoroughly meets the required dimensions of the EN 1729-1:2006 standard. All the measured samples have deviations from the prescribed dimensions.
Such results lead to the conclusion that while choosing and purchasing school furniture, i.e., desks there is no control whether they meet the requirements of the obligatory standards.
The biggest and most common deviations are connected to the design of the desks as well. In four of the samples, there is a provided space for leaving objects in the lower zone. In all four samples this element impairs the space for the legs. This element is not most suitable for leaving the objects and it also has a great negative impact concerning sitting on the desks.

| Sample No. | Height group | Deviations |
|------------|--------------|------------|
| Sample 1   | 2 violet     | There is a minimal deviation in the minimal width per person, because the desk is meant for 4 persons simultaneously. |
| Sample 2   | 4 red        | The free space for legroom is impaired with an object for delay of the down part of the desk. |
| Sample 3   | 4 red        | The free space for legroom is impaired with an object for delay of the down part of the desk. |
| Sample 4   | 5 green      | The free space for legroom is impaired with an object for delay of the down part of the desk. |
| Sample 5   | 6 blue       | The free space for legroom is impaired with an object for delay of the down part of the desk. |

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