

STREET FURNITURE FOR SENIORS

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Abstract

Street furniture is an independent discipline. It addresses detailed solutions of products designed for human use in an exterior environment. Based on present-day studies, senior citizens constitute the fastest growing segment of the population. The sample element with defined ergonomic parameters has been defined by analyzing the standard and most used component of street furniture – bench, by the comparison of used materials and chosen construction. During the comparison and the subsequent conclusions, a great emphasis was placed on the functionality and durability of the individual components. The categories of street furniture have been based on the study of production programs of mainstream furniture manufacturers in Europe, and on the research of factors influencing street furniture. With the basic material of the supporting structure, the sitting and leaning sections and based on the measurements and defining of materials, a sample construction design has been proposed, and supporting element of concrete, steel and wooden constructions including their surface treatment has been described.

Keywords: factors, function, functionality, furniture design, material, senior, square, street, street furniture, urban areas, urban zone

INTRODUCTION

The increasing average age of humans places a great emphasis on the quality and healthy lifestyle in all population groups. The main parameter of contemporary standards is a healthy and quality environment, where people live and spend their time. The need of quality public spaces and quality body-conforming street furniture has been on the rise. This work focuses on street furniture for senior citizens. This street furniture is designed solely for outdoor use. The aim of this dissertation thesis is to propose a basic type of seating for seniors created with an analysis of the present-day typical elements of street furniture, and with a comparison of individual environments and materials. Based on the analysis, conclusions have been drawn and compared for typical constructions from various materials.

MATERIALS AND METHODS

A general result has been obtained by the induction method and based on the observed information from already completed works, and a possible solution for the future has been deduced. The typical example – the bench – has been compared by the analysis from the perspective of basic size, materials and construction. A sample solution has been designed. Gathering of data on the categories of street furniture is based not only on factors that influence street furniture, but also on the production potential of important furniture designers and manufacturers.

RESULTS

Leonardo da Vinci in his manuscript “La città ideale” was one of the first people who began to address urban areas. Upon discovering that the

population of Milan had reached 50,000 in 1486, he became the first urbanist to design a plan for a modern and rationally-conceived town. There were listed the factors necessary to create street furniture (Kanická and Holouš, 2011; Tesařová and Šebelová, 2013; Cremante and Pedretti, 2005).

Sociological factors are based on the sociological research of towns. Individual colonization groups have their inherent rhythm and culture that influences the expansion or shrinking of an area, resulting in the formation of social circles. Each circle behaves differently and uses a different type of street furniture.

Psychological factors, particularly haptic (tactile) characteristics, go hand in hand with the temperature and humidity of the individual placement of street furniture. This furniture, depending on the location, can be used by people in both severe winters and hot summers. Thermoregulation, as a system to maintain a constant temperature of the human body, adapts to the environment. Based on research conducted in 1998 regarding the behavior of materials subjected to extreme temperatures, Kodur and Baingo developed a strength-temperature curve suitable for defining the sensitivity of basic materials at 20 °C. Their results imply that the sensitivity of wood is three times smaller than steel and four times smaller than concrete (Kodur and Baingo, 1998), having a significant haptic impact on the contact areas between the human body and sections of the street furniture.

Ergonomic factors (anthropometrics and biomechanics) constitute requirements that correlate with the characteristics and spatial capacity of humans, their physique, body-size and limbs, movement stereotypes and fitness, all of which change with increasing age.

Furthermore, aesthetic factors are also very important. Each of us definitely saw damaged and dirty rubbish bins or benches where it was impossible to sit. Therefore, it is necessary to use materials and create products in such a way that it would be possible to clean or replace them without any great effort.

Division of Street Furniture

There is no available category of street furniture, therefore, the category has been made based on the above parameters.

Design of Furniture in Urban Areas

The locations for which street furniture is designed, are based on requirements and activities of their users. Infrastructure and availability change according to their needs over the course of time. It is therefore necessary to ensure the comfort of people who commute from where they live to their workplaces every day. Individual areas are already divided according to town planning schemes into working, living, recreation and transport zones.

Some zones intermix due to the development of new technologies. It is not now a problem to work outside the office and to use the internet and telephone in all zones, where it was not possible in the past. „Points“ that offer the necessary comfort have started to appear (Walker (with an essay by Gillette), 2005; Krauel, 2007).

The design of individual street furniture elements should be function-oriented. Shapes and colors should not be dominant, but rather blend with the environment in which they are placed. Of course, if we want to add another function to the furniture, e.g. aesthetic or artistic, when, despite its functionality, to use the piece as a work of art, we can create a dominant and highly-visible stand-alone object (Walker (with an essay by Gillette), 2005; Krauel, 2007). Seniors who are more and more active use street furniture for short rests, discussions with colleagues or when waiting for the bus. Short-term use can be defined as not exceeding 5 minutes. When used for longer time, it is assumed that it will be used for relaxing, making a phone call, browsing on the internet, watching the surroundings and resting. In production, materials that are more costly have already started to be used and the development of technologies and materials will continue. Our technologies change, and thanks to advanced research, we are able to create new and newly-modified materials from elements such as carbon. Similarly, street furniture products will improve accordingly.

Location of the Street Furniture in the Public Space

According to Aristotle, the smallest component of a household is a person. People live in households that make up the community. The village is called polis. Polis arises naturally and develops in a way to ensure maximum self-sufficiency. Mostly built up by elements or parts of elements, but it can also be a natural area. Polis – a mansion, can be divided into districts and urban blocks. Urban block is a public space of elements cooperating with common compositional and functional relationships. The basis is an effort to create a coherent group of mutually supportive elements, which together form a public self-contained space, which, by its characteristics, connects to neighboring spaces and together with other blocks forms a polis. Even though the public space is independent and self-confident, it must build on the whole. If there is no relationship created between the individual spaces, not just the urban block, but the whole polis does not have the character of a municipality, it loses its value and does not contribute to the development of the whole. It is also necessary to approach city furniture in a similar way, as it is part of and one of the elements of the polis. Therefore, it is not possible to divide and close this space exclusively for seniors or other target groups. Every urban space where

I: *Categories of street furniture according to products*

Categories of street furniture according to products (Burgess and Bogue, 1964; Poštulková and Teplánová, 2008; Čevela, Kalvach, and Čeledová, 2012; Mühlpachr and Staníček, 2001; Malíková, 2011): If the products meet basic technical and ergonomic parameters, they can be classified as street furniture, especially when they are used in urban areas. Street furniture for senior citizens can be categorized similarly. If furniture is to be installed in areas frequently attended by seniors, e.g. in the vicinity of retirement homes, it should be barrier-free and fitted with aid and support elements.			
Based on the production method	Standardized furniture	Products designed for mass production. These products are adjusted to the capacity of mass production; their design is generally neutral, with an emphasis on detail. They have the ability to be adapted to many variants of the environment where they will be installed and used.	
	Atypical furniture	Emphasis is placed on the artistic features. Products are designed for a specific place, where they usually become dominant. Production technology is often more	
Based on the function	Service	Sale stands, roofing, public transport stops, shelters, sunshades, rubbish bins, ashtrays, tree grids	
	Safety	Noise barriers, public lighting, protective railing, bollards, barriers	
	Informative	Bigboards, billboards, CLV, information panels, information boards, information systems	
	Relaxation	Areas, playgrounds and elements for sports use, benches, seats, armchairs, tables, bike racks, drinking fountains, fountains.	
Based on the age groups	Aesthetic	Historical and artistic elements in the space – sculptures, architectural elements	
	Demographic development of the population indicates that by 2030 the number of seniors will grow by 40–80% and by 2050, those over 65 will constitute 1/3 of all inhabitants. In the Czech Republic there will be approximately 1 million people over 80 years of age. Health condition and fitness will differ from present-day seniors. The health condition of people and their life ambitions will increase. This will significantly change the role of seniors in the society.	Basic street furniture (people aged from 6 to 74 years)	At early old age, seniors are able to use standard street furniture.
		Street furniture for seniors (people aged from 75 to 89 years)	Seniors should be in better health condition and more fit than present-day seniors.
		Street furniture for longer-living people (90 years and more)	
Based on the public space typology	A great emphasis is placed on the functional organization of the given area, connection to infrastructure, optimum location and possibilities of the future development of the zone.	Urban zones: 1. Squares 2. Streets and transport areas (public transport stops, train stations) 3. Relaxation, recreation, resting and sport zones	Furniture is exposed to a greater strain, especially increased dustiness and more frequent use, and there is also a greater probability of furniture destruction.
		Village zones	Less strained pieces of street furniture.
		Other zones	

we place urban furniture has its own storyline. The storyline of space is influenced by the space itself and matter (individual elements). Therefore, it is necessary not to exclude urban furniture for the elderly, but rather to supplement or modify the existing parameters of urban furniture and urban spaces so that the furniture fulfills its function for both the elderly and other users (Jehlik, 2016).

Street Furniture Construction and Materials in Urban Areas

Besides the above-mentioned sociological, ergonomic and aesthetic factors, the most important characteristics of furniture products are durability, functionality and stability. The continued development of new materials and technologies brings new possibilities for developing street furniture. 3Dprinters are able to process materials from non-ferrous metals and alloys or cement-

II: *Categories of street furniture according to the typology of public spaces*

Division of city furniture according to a location in public space			
Categories of street furniture for seniors according to detailed elaboration of the typology of public spaces			
According to the mode of use of street furniture in place	Furniture for time-limited use	Safety barriers, portable benches, stackable seating	
		Furniture designed for gathering users (squares, parking lots, parks, campuses) safety barriers, garbage bins	
	Furniture for clearly defined activity in space	Furniture for the movement of users (streets, beaches, embankments) bus stop, railing	
		Furniture designed for sport (sports facilities, the area in front of stadiums) bicycle stands	
		Furniture for recreation (parks, recreation areas) benches	
According to the characteristics and form of the space in which they are located	Furniture designed for orientation of users (streets, crossroads, squares, railway stations, airports) orientation system, CLV		
	Elements in the central form of space		They have a static character, mostly in central position and center of gravity
	Elements in the linear form of space		They have a dynamic character, they are more influenced by external factors in space, they can optically create movement between several poles
	Elements linked to other nearby objects		
	Elements with some degree of autonomy		
Depending on the types of spaces or areas intended for urban furniture	Furniture for reinforced surfaces	Furniture for constructed or adapted areas (French type gardens, university and corporate areas)	
	Furniture for not reinforced surfaces	Furniture for natural areas or areas with flora and fauna (English type gardens, hiking trails)	
By the limit of the space accessibility in which they are located	Elements of furniture in general use (public city furniture)	Furniture in public space with maximum accessibility regardless of product owner	The furniture is located in squares, parks, streets, public playgrounds
	Elements of street furniture in limited use (private street furniture – private)	Elements in a restricted area (restricted by the owner or product manager)	The furniture is located in sports facilities, in university campuses, inside the corporate areas
Depending on the location of the area where the furniture is located	Location in the center		
	Location in the neighborhood		
	Location outside the polis		

based materials. This facilitates the production of custom-made items, exactly tailored to individual areas. It is possible to use lightweight concrete parts that can be dyed, preserving their color for a longer period. The proper use of materials, the proper design of construction and suitable production methods facilitate the meeting of all the above-mentioned input characteristics. Ideal materials for street furniture are those with sufficient strength,

durability and surface stability, abrasion-resistant, UV protection and relatively color-stable surfaces. The initial requirements of investors include the type of construction methods and maintenance requirements (the area where the product will be situated is the main requirement, and at the same time, the main limitation). Suitable materials and construction have to be used for different environments.

In the aggressively, corrosive seaside areas, it is most suitable to use stainless steel grade 1.4057/431, class 17, e.g. pursuant to the Czech Technical Standard CSN 17145. This steel is resistant to corrosion in a mildly aggressive environment of water and steam with a low content of chloride ions present, especially in seaside areas. Surface treatment in flat, stainless components achieves the maximum surface roughness R_a [μm] of 3.2. This is especially important if the object is used for transportation structures. The most exposed examples include train and tram tracks. When the surface is insufficiently treated, fissures in the surface are filled by microscopic particles present in the air. These particles, when they originated from rails with frequent electrochemical reactions with the environment, create a visible layer of surface corrosion, which is undesirable in stainless materials.

In our climatic conditions, we can use standard welded steel grade S235JRH (1.0039), pursuant EN 10219-1, class 11 375 with a minimal amount of problems. When steel strips are used, special attention must be paid to bends in the steel strips. It is essential, especially in small radiuses, to use drawn steel, grade 235JR (1.0038) pursuant EN 10025-2, class 11 375 because of its mechanical properties. Basic surface protection treatment is by hot-dip zinc 90 μm galvanization. Another possibility is steel-grit blasting of the material (for SA 2.5) and subsequent zinc metallization (thermal spraying) (approx 120 μm). The resulting surface treatment is applied in the form of a coating, either sprayed or powder lacquer coated (komaxit), the minimum thickness at least 240 μm .

When concrete is used for the supporting structure, it is ideal to use cast compacted (vibrated) concrete from molds. During the vibration process, potential cavities are filled and the trapped gas released, resulting in a concrete surface that is smooth, aesthetic-looking and is extremely durable. Concrete composition is standardized, pursuant to CSN EN 206-1, with an expected lifespan of 50 years. We use white or grey cement, natural sands, gravel or ground stone, for the dyeing of mineral paints. Concrete parts are reinforced with steel sections due to static reasons. It is necessary to pay close attention to the level of the environmental impact

to which the concrete will be exposed. Seaside areas with an aggressive chemical environment due to the impact of chlorides from sea salt and acidity $\geq 200 \text{ ml/kg}$ are according to Baumann-Gully in class XA1–XA3, i.e. chemically, a very aggressive environment. Concrete used in this environment must meet the standard CSN 72 2103. In the standard environment with periods of freeze and thaw, i.e. class XF1–XF4, aggregate with sufficient frost-resistance is used, pursuant to CSN EN 12 620. When there is a requirement to reduce the weight of the concrete construction, we use concrete with bulk density greater than 800 kg/m^3 and smaller than 2000 kg/m^3 . Standard bulk density of concrete is greater than 2000 kg/m^3 but not exceeding 2600 kg/m^3 .

If we decide to use wood, manufacturers of street furniture most often use surface-treated pine, beech and tropical woods like jatoba (origin: Central and South America) and massaranduba (origin: northern part of South America, south of Central America). These woods can also be treated with teak oil. Domestic woods must be treated against ligniperdous fungi, molds and water by a suitable agent to increase their resistance, e.g. oils. These oils are absorbed and prevent the wood from drying as well as from dampness. The ideal agent is flaxseed oil (seeds of flax are crushed and cold-pressed by great pressure, yielding up to 90% of oil), which can be diluted with turpentine oil, orange oil or dearomatized white spirit. It provides deep protection of wood and wooden surfaces. Other methods of protection include natural oil-based stains and paints, which penetrate deep into the wood pores, perfectly adhere and do not flake off. They gradually evaporate and thinner, therefore it is necessary to count on the maintenance. There is another type of material, thus far untested, that can be used in street furniture; a novelty bamboo-based construction profile made by lignin plasticizing.

Comparison of Bending Strength Between the Bamboo Profile and Standard Wooden Profiles used in Urban Areas and Public Spaces

Table providing comparison of basic anthropometric dimensions according to Dlabal (1976); Panero and Zelnik (1979) and the standard

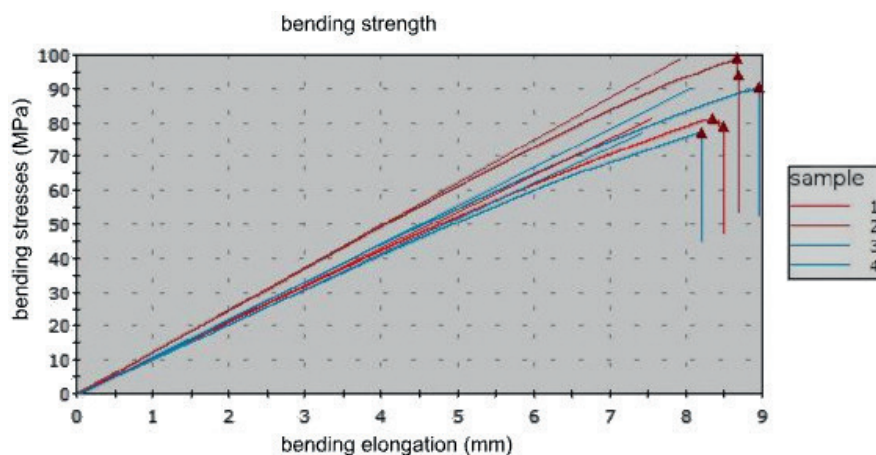
III: Values of the tested material

Hardness	Brinell Hardness	$\geq 9.5 \text{ kg/mm}^2$
Density		$\pm 1 200 \text{ kg/m}^3$
Strength	EN (408)	50.30 N/mm^2
Durability	EN 350/ENV807	Class 1
Class of material use	EN 335	Class 4
Fire resistance	EN 13501-1	Class B-s1-d0
Dimensional stability	24 hours in water at 20°C : + 0.1% length, + 0.9% width	

IV: Description of the test batch: profile $18 \times 15 \text{ mm} - 400 \text{ mm}$ (bending strength)

Speed 1

4.00 mm/min



	Maximum bending load (N)	Bending strength (MPa)	Flexibility Module (Automatic) (MPa)	Stretching by bending (mm)
1	695.74	81.149	13 391.20308	8.34
2	847.79	98.883	15 486.05259	8.67
3	773.83	90.256	13 982.02290	8.95
4	662.36	77.255	12 957.71631	8.20
Diameter	744.93	86.886	13 954.24872	8.54
Maximum	847.79	98.883	15 486.05259	8.95
Minimum	662.36	77.255	12 957.71631	8.20
Standard deviation	82.97	9.677	1 104.12737	0.34
Median	734.78	85.703	13 686.61299	8.51

CSN 910620 providing dimensions of street furniture for seniors, based on average values in the street furniture made by the company mmcity. Standard dimensions of street furniture are based on deduction of the research optimization using the Manouvrier's Anthropometric Research Method (Kučelka, 1999, pp. 106–107) (Dlabal, 1976; Panero and Zelnik, 1979; Hřčková and Šarapátková, 2004).

Comparison of Street Furniture for Seniors with Standard-size Street Furniture (NIS, 2013)

Ergonomic factors (anthropometrics and biomechanics) constitute requirements that correlate with the characteristics and spatial capacity of humans, their physique, body-size and limbs, movement stereotypes and fitness, all of which change with increasing age.

These are the reasons for the research and design modifications of anthropometric requirements and seating biomechanics for the largest group of the population, ie seniors. As a result, the seating parameters are adapted to their requirements.

A seat with an adjustable seat angle and backrest angle is used to obtain the measured values. The test seat was designed to change the seat height as well. The armrests have been adjusted to the size of 195 mm from the seat surface. This dimension pursuant the norm CSN 910620 – upper elbow rest level – a middle of seat functional area.

Persons of average size in the age of seniors were chosen as figurants:

- Man height 179 cm and weight 85 kg.
- Woman height 167 cm and weight 80 kg.

The selected persons are based on the table and calculations of the individual size group values (XS–XL) and correspond to the input values and calculated percentiles for the Unisex dimensions. Current anthropometric size measurement values are:

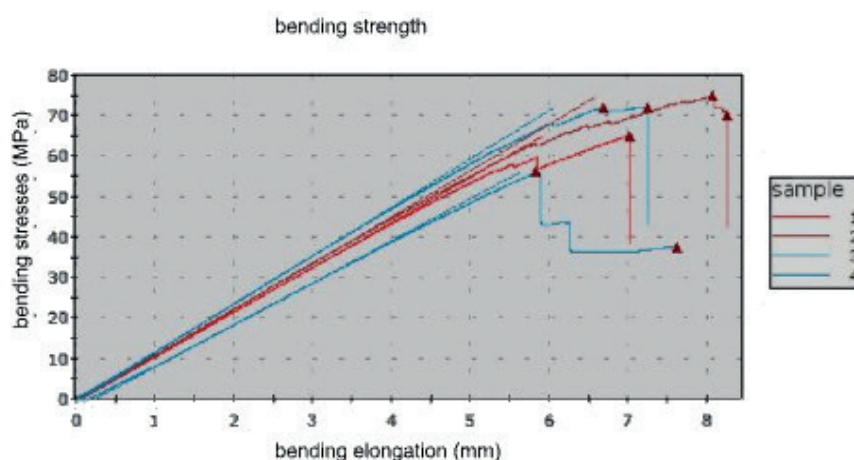
- S: 25.percentile = 165.1.
- M: x = 172.7.
- L: 75.percentile = 180.1.

The measurement took place from 2009 to 2012 and was carried out within the project NIS “Furniture Information System for the Support of

V: Description of the test batch: profile $32 \times 15 \text{ mm} - 400 \text{ mm}$ (bending strength)

Speed 1

4.00 mm/min



	Maximum bending load (N)	Bending strength (MPa)	Flexibility Module (Automatic) (MPa)	Stretching by bending (mm)
1	1 310.45	65.071	11 887.05167	7.03
2	1 507.41	74.851	12 231.86963	8.08
3	1 451.90	72.094	12 833.45753	6.69
4	1 127.49	55.986	11 113.74096	5.84
Diameter	1 349.31	67.001	12 016.52995	6.91
Maximum	1 507.41	74.851	12 833.45753	8.08
Minimum	1 127.49	55.986	11 113.74096	5.84
Standard deviation	169.54	8.419	717.75912	0.93
Median	1 381.17	68.583	12 059.46065	6.86

Research, Development, Innovation, and Quality of Furniture” at the Department of Furniture, Design and Housing, Mendel University in Brno under the guidance of doc. Dr. Ing. Petr Brunecký. The measurements were carried out by employees of the Department of Anthropology, Faculty of Science, Masaryk University – Mgr. Martin Čuta, Ph.D. (NIS, 2013). Measured values were approximated to whole numbers.

Methods of Research

Using analysis, an adjustable seat-cushion element is designed and manufactured to match the elementary dimensional attributes. Construction was designed to be flexible with the possibility to adjust angles and height. The method of analysis was accomplished by gradual adjustments of the basic angles and heights of the seat so both, the male figurant and female figurant obtained the best subjective feeling during the three basic activities:

- Sitting down.
- Sitting itself.
- Raising from a sitting position.

On a scale from one (the best subjective feeling) to five (the worst subjective feeling). according to analysis results found, and the comparison of the measured data are proposed seating dimensions for the proportionally standard senior.

Measured Values

Trying the LV250 bench, the figurants experienced the greatest problems while raising from the seats, then sitting down. The sitting itself on the bench was without problems. After the measurement process, the following dimensions were the most successful:

- A = 505 mm (sitting knee height – seat height).
- U1 = 8° (seat angle).
- U2 = 100° (angle between the seat and backrest).
- P = 195 mm (elbow height, seated (in flexion) – armrest height (upper elbow rest level – the center of the seat’s functional surface), (mm).
- V = 1 by the male figurant and V = 2 by the female figurant (rating of activity on adjustable seat-element: subjective feeling).

VI: Comparison of wood standardly used in urban areas with industrially made bamboo profile

Larch	112	Mpa	12% RVD
Bamboo profile	111	Mpa	12% RVD
Beech	109	Mpa	12% RVD
Oak	108	Mpa	12% RVD
Pine	86	Mpa	12% RVD
Spruce	80	Mpa	12% RVD

VII: Input values explanations

A	Seated kneepit height – seat height (mm)
U1	Seat angle (- °)
U2	The angle between the seat and backrest (- °)
P	Elbow height, seated (in flexion) – armrest height (upper armrest level – the center of the seat's functional surface), (mm)
V	Rating of activity rating on adjustable seat-element (subjective feeling)
MM	Rating of activity during the measurement on bench Vera LV250 (mmcité) (subjective feeling)

VIII: Values of seat cushion adjustments – figurant man

Figurant – man					
A	450	480	485	505	515
U1	3°	7°	8°	8°	8°
U2	95°	100°	95°	100°	100°
P	195	195	195	195	195
V	3	4	3.5	1	1.5
Standard bench dimension LV250					
MM	3				

IX: Values of seat cushion adjustments – figurant woman

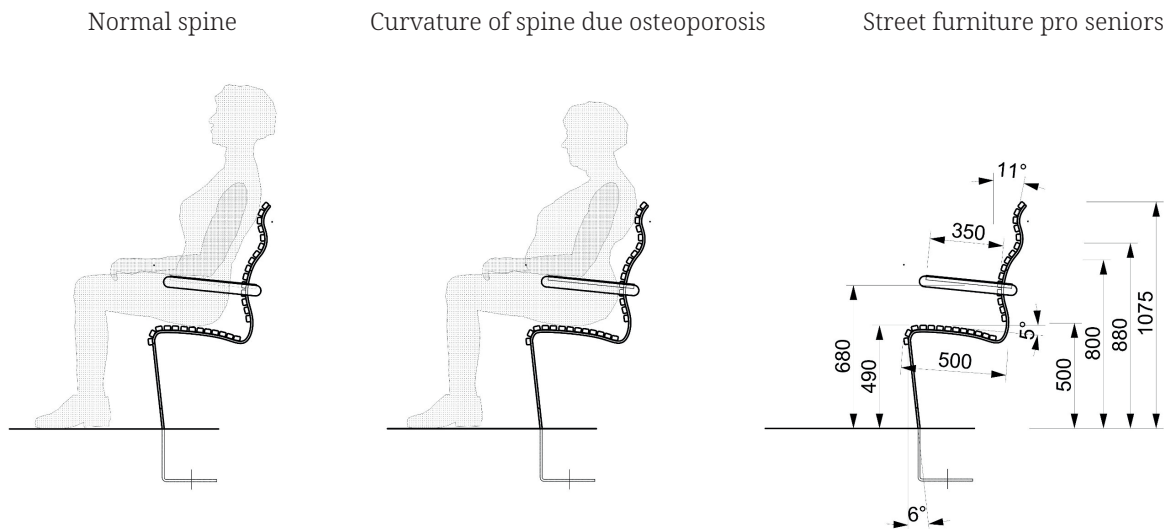
Figurant – woman					
A	450	480	485	505	515
U1	3°	7°	8°	8°	8°
U2	95°	100°	95°	100°	100°
P	195	195	195	195	195
V	3	4	3	2	2.5
Standard bench dimension LV250					
MM	2.5				

X: Comparison of dimensions of furniture Standard, mmcité and furniture for seniors

	Basic mean values Standard (mm)	Basic mean values: street furniture mmcité (mm)	Street furniture for seniors (mm)	Deviation from standard (mm)
Upper height of lumbar support	840	840	840	± 0 mm
Height of arm support	630	630	680	+ 50 mm
Minimum bottom height of backrest	500	500	510	+ 10 mm
Seat height	420	450	500	+ 80 mm
Seat depth	450	500	500	+ 50 mm
Internal distance between armrests	550	550	550	± 0 mm
Seat width	400	430	500	+ 100 mm
Length of armrests	280	300	350	+ 70 mm

Changes in the basic dimensions of furniture for seniors are based on the measured changes in the human body caused by osteoporosis. Changes in height and shortening of the spine can occur from

the age of 50. The difference between a normal spine (age 40) and the maximum curvature of the spine due to osteoporosis (age 70) is approximately 9%.



1: *Proposal of adjusted seat, metal, wood*

Source: Mrázek, M. Proposal of adjusted seat, metal, wood

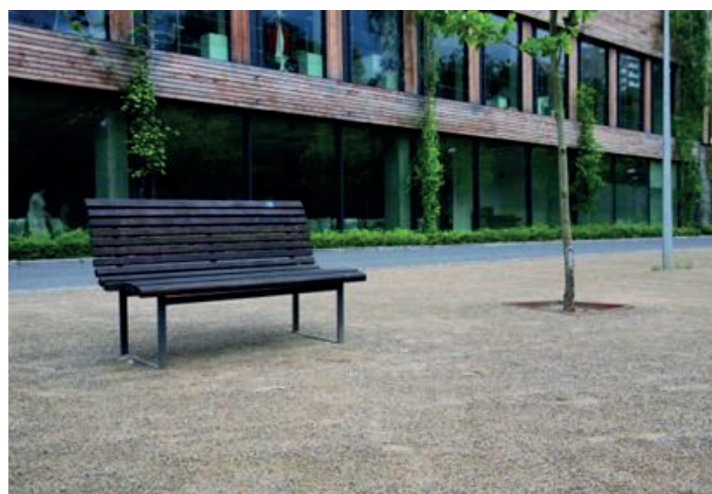
DISCUSSION

Based on the available information, there is practically no literature on street furniture for seniors presently available. This work builds on practical experience from designing, construction and production of street furniture and products from prominent European companies working in this area. The family company Escofet, which has worked in Barcelona since 1886, along with others, has participated in the construction of *Basílica i Temple Expiatori de la Sagrada Família* since its establishment. At present, it is a company offering top quality street furniture produced from concrete. Another important company is one of the largest European firms producing street furniture, the

Czech company *mmcité*, which produces cutting-edge furniture from steel profiles and wood.

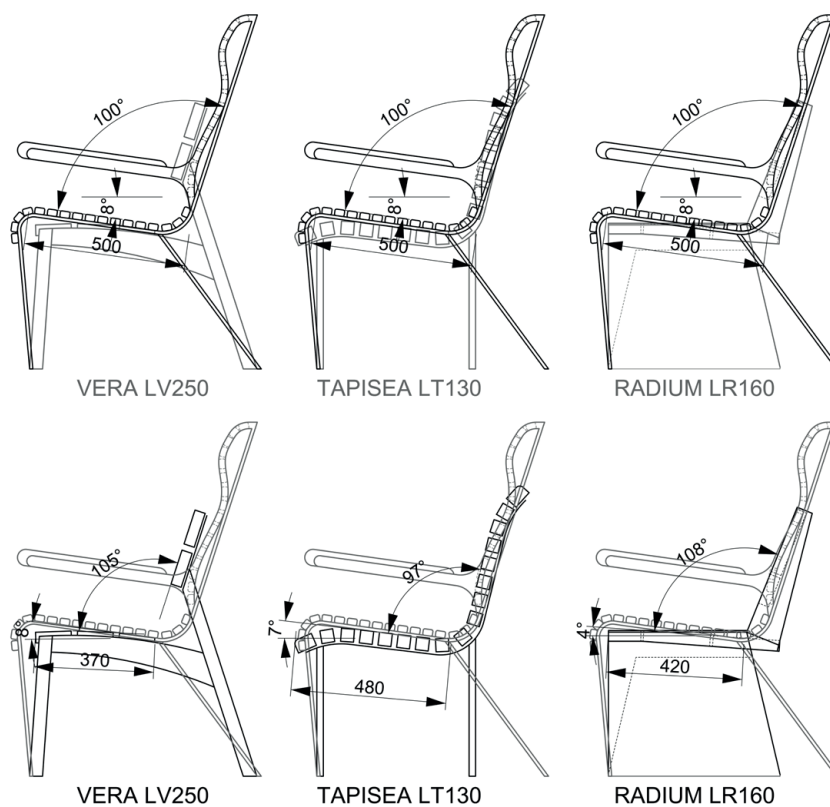
Compared piece of street furniture made by *mmcité* (Fig. 4).

This piece of furniture by *mmcité* has been designed as a square tube weld, surface treated by hot-zinc dip and powder coated. The wooden parts of the seat were originally supplied in white, with surface treatment, white stain. However, there was a problem with the closing of the wood pores; insufficient maintenance resulted in a reduced lifespan of the seat. It is more suitable to use silicone base to increase the water repellence and acrylic paint, or ideally, colored oils and waxes or mordants.



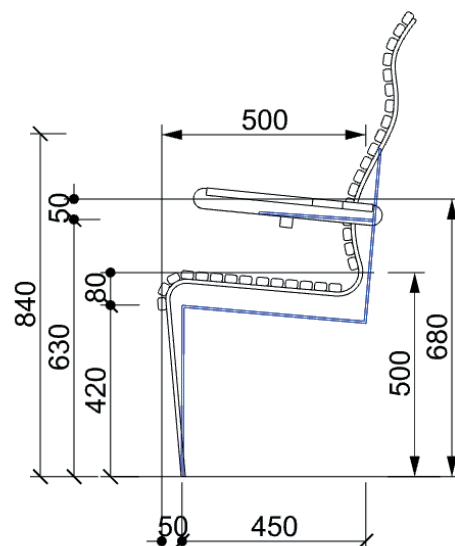
2: *mmcité, Tapisea, Hruša & Pelčák Architects, bench metal, wood*

Source: *mmcité*. Available at: <https://www.mmcite.com/#!parkovlavicky>



3: Comparison of benches mmcité and street furniture for seniors, benches, metal, wood
Source: Mrázek, M. Comparison of benches mmcité and street furniture for seniors, benches, metal, wood

Comparison of standard and seat for seniors

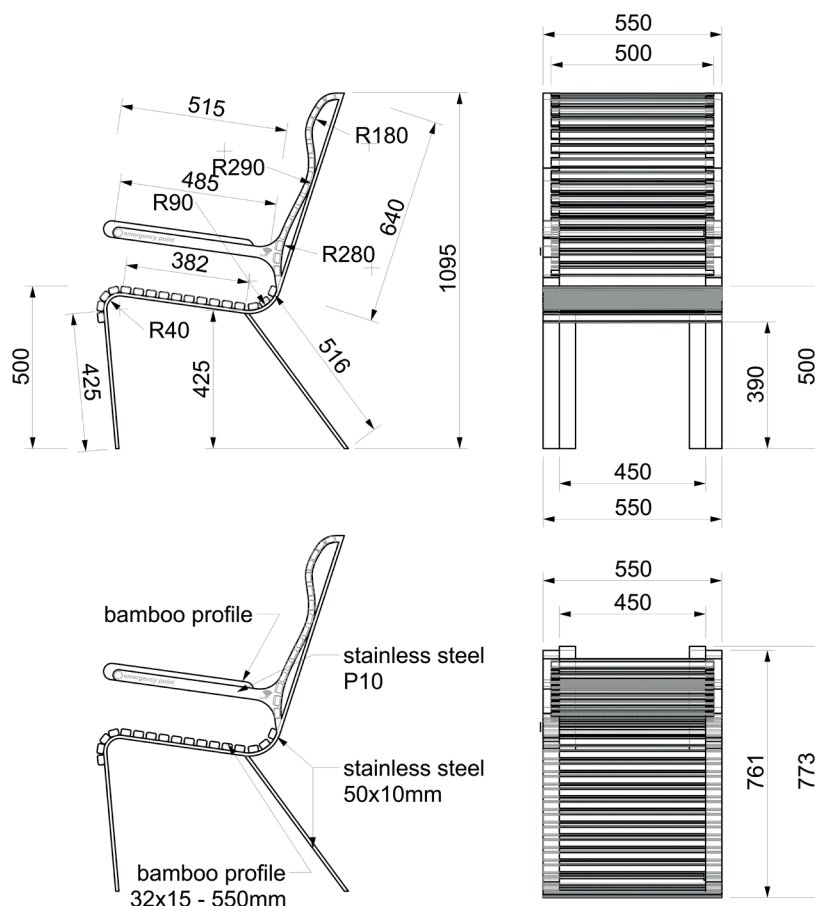


4: Comparison of street furniture for seniors with standard-size street furniture
Source: Mrázek, M. Comparison of street furniture for seniors with standard-size street furniture

CONCLUSION

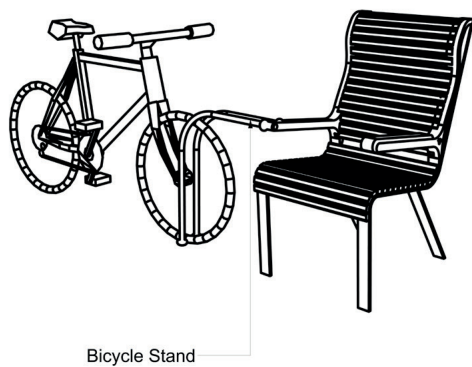
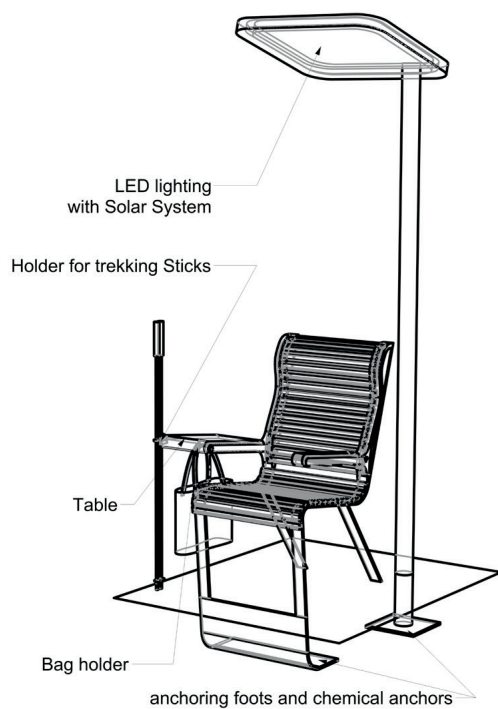
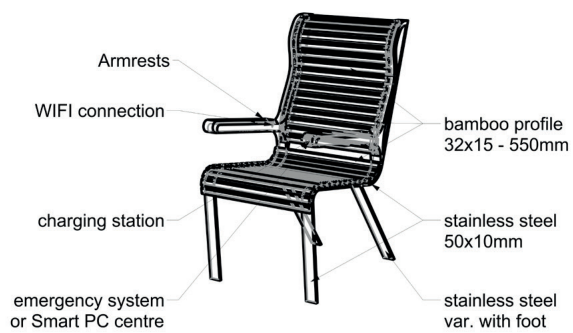
The result of this work proposes to define the standard characteristics that must be observed when designing street furniture, the concept of street furniture for seniors and for the use of suitable materials for a specific environment. The standard bench for seniors can be used in mild climates, which includes a large part of Europe. The frame is made of simple welded construction from steel, quality S235JRH (1.0039), pursuant to EN 10219-1, class 11 375, surface treated by 90 µm hot-zinc dip and 120 µm powder coating. Construction should be simple to facilitate easier and cheaper production. Steel construction with well-designed statics ensures great stability of the bench and resistance to vandalism. Parts that come in contact with the human body, both directly and indirectly, should ideally be made from domestic or tropical types of wood. The seat and rests should be constructed from industrial profiles such as the above-mentioned bamboo profile. Domestic wood (ideally beech, oak, pine) must be treated with oil against ligniperdous fungi, molds and water to increase its resistance. All connecting parts are from stainless steel, grade 1.4057/431, class 17. Anchoring to the concrete base and into the concrete is made by anchoring foots and chemical anchors.

Sample design of a piece of street furniture for seniors meets all constructional, functional and ergonomic attributes. Parameters are based on practice with designing, constructing and experience gained in the production of furniture. It differs from standard street furniture by its size and various other functions, which are now necessary to gain more comfort and generally meet the seniors' needs. Outdoor sitting furniture for seniors is complemented with LED lighting, WIFI connection, a charging station and connection with an integrated emergency system or functional PC centre or Smart centre facilitating the connection to other digital mobile devices.



5: Description of basic dimensions

Source: Mrázek, M. Description of basic dimensions



6: Various other functions of street furniture for seniors
Source: Mrázek, M. Various other functions of street furniture for seniors



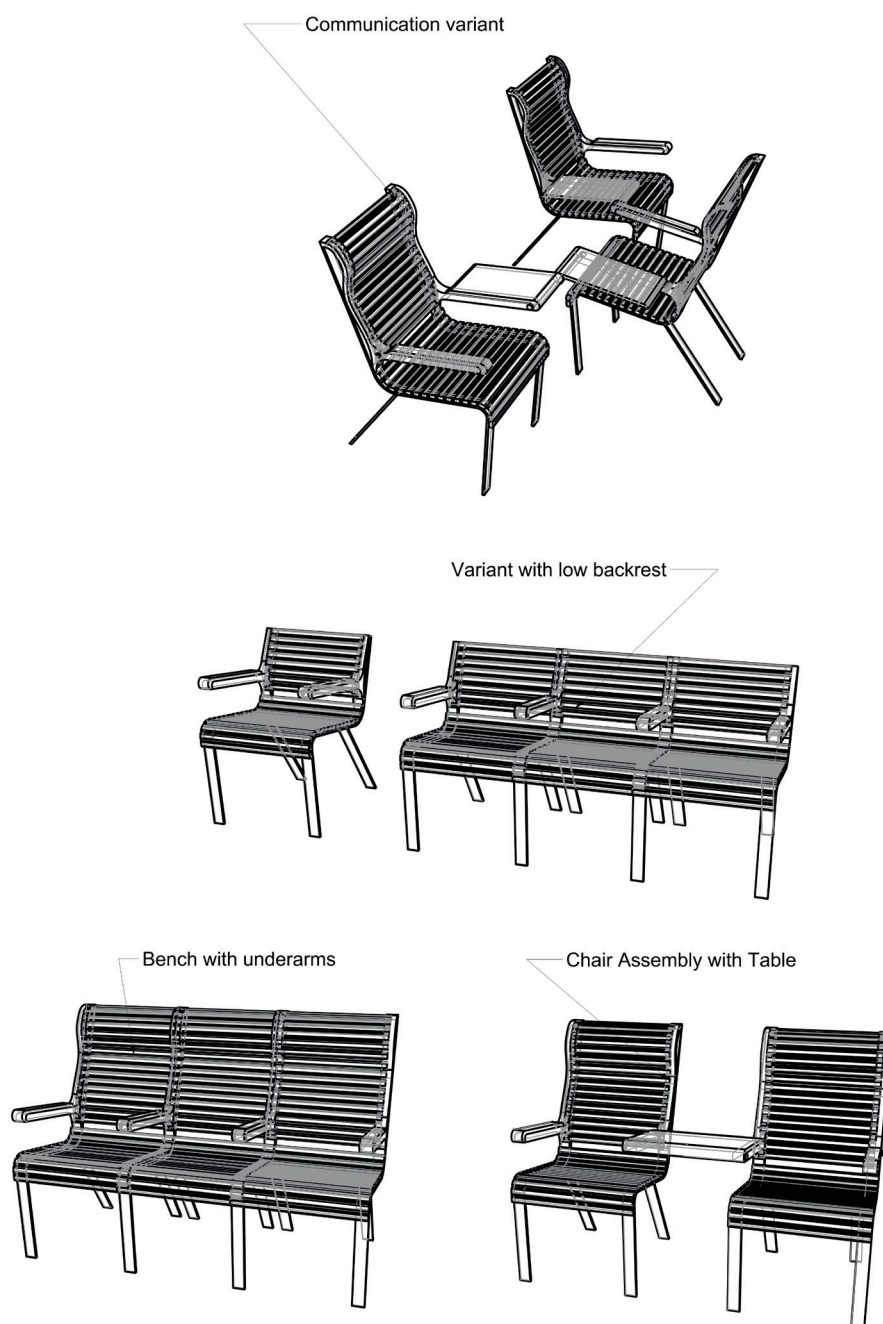
7: Proposal of the solution of street furniture for seniors, bench, metal, wood
Source: Mrázek, M. Proposal of the solution of street furniture for seniors, bench, metal, wood



8: Proposal of the solution of street furniture for seniors, bench, metal, wood with accessories
Source: Mrázek, M. Proposal of the solution of street furniture for seniors, bench, metal, wood with accessories

Demonstration of Modification fot Multiple Users

Usage variations of furniture seats for seniors depend on the specific locations. The individual modifications are always based on the need to create a comprehensive space where the elements of the street furniture support each other and form an independent unit that follows up the surrounding spaces.



9: *Demonstration of modification fot multiple users*

Source: Mrázek, M. Demonstration of modification fot multiple users

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REFERENCES

- ARISTOTELÉS. 1998. *Politika (kniha I. a III.)*. Praha: Nakladatelství Petr Rezek.
- BURGESS, E. W. and BOGUE, D. J. 1964. *Contributions to urban sociology*. Chicago: University of Chicago Press.
- CREMANTE, S. and PEDRETTI, C. 2005. *Leonardo da Vinci: artista, scienziato, inventore*. 1st Edition. Firenze: Giunti.
- ČEVELA, R., KALVACH, Z. and ČELEDOVÁ, L. 2012. *Sociální gerontologie: úvod do problematiky*. 1st Edition. Praha: Grada.
- DLABAL, S. 1976. *Nábytek, člověk, bydlení*. Praha: Ústav bytové a oděvní kultury.
- HRČKOVÁ, Y. and ŠARAPATKOVÁ, H. 2004. Osteoporóza. *Interni Med.*, 6(1): 37–39.
- JEHLIK, J. C. 2016. *Rukověť urbanismu, architektura poznání a navrhování prostředí*. 1st Edition. Praha: Ausdruck Books.
- KANICKÁ, L. and HOLOUŠ, Z. 2011. *Nábytek: typologie, základy tvorby*. 1st Edition. Praha: Grada.
- KODUR, V. K. R. and BAINGO, D. 1998. *Fire Resistance of FRP Reinforced Concrete Slabs*. Ottawa, ON, Kanada: Institute for Research in Construction, National Research Council of Canada.
- KRAUEL, J. 2007. *New urban elements*. Barcelona: Links Books.
- KUŽELKA, V. 1999. Osteometrie. In: STLOUKAL, et al. (Ed.). *Antropologie: Příručka pro studium kostry*. Praha: Národní muzeum.
- MALÍKOVÁ, E. 2011. *Péče o seniory v pobytových sociálních zařízeních*. 1st Edition. Praha: Grada.
- MÜHLPACHR, P. and STANÍČEK, P. 2001. *Geragogika pro speciální pedagogy*. 1st Edition. Brno: Masarykova univerzita.
- NIS. 2013. Výzkum. *NIS: Nábytkářský informační systém*. [Online]. Available at: <http://www.n-i-s.cz/cz/vyzkum/page/61/> [Accessed: 2019, November 15].
- PANERO, J. and ZELNIK, M. 1979. *Human Dimension and Interior Space*. Princeton: Architectural Press.
- POŠTULKOVÁ, L. and TEPLÁNOVÁ, E. 2008. *Typológia II – Zaridovacích prvkov verejného a pracovného priestoru*. Zvolen: TUZ.
- TESAŘOVÁ, D. and ŠEBELOVÁ, E. 2013. *Trendy v nábytkářství a bydlení. Křtiny*. 1st Edition. Brno: Mendelova univerzita v Brně.
- ÚNMZ. 1981. *Standard for the production and delivery of chairs of wood or metal, similarly providing dimension*. ČSN 91 0620 (910620). Praha: ÚNMZ.
- WALKER, P. (with an essay by GILLETTE, J. B.). 2005. *Peter Walker and Partners: defining the craft*. 1st Edition. San Rafael, Calif: ORO Editions.

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