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THE ANALYSIS OF FURNISHING AND DESIGNING OF DIAGNOSTIC CENTERS WITHIN SPORTS OBJECTS¹

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Abstract: The increasing development of mankind can be seen in the progress in the design of sports facilities which must satisfy certain high standards of construction and equipment and which need to offer a maximum number of services in their environment in order to meet the needs of customers. One of the major positive influences on users includes opening diagnostic centers within sports objects which must be furnished properly and functionally. When furnishing and designing the interior, it is necessary to pay attention to the choice of colours, floor materials, lighting, and most importantly – the equipment that will be used in the premises of the center. They can be separated into zones: medical rooms, laboratory, and diagnostics and training area. Each of these zones has different requirements for equipment with special attention to the privacy of the patients being tested, their safety and keeping the space clean.

Key words: sports objects, diagnostic centers, interior design, furnishing the interior

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**Introduction**

One of the most fundamental preconditions for implementing sports activities and their professional monitoring is the existence of the appropriate sports facility. It is impossible to organize any individual or group activities without the adequate sports facilities and additional facilities as an essential resource. All of the above enables fulfilling the sports potential, that is, achieving sports results as the main goal in sports. It is not enough only to have the appropriate number of the facilities, but also to have the objects which meet the prescribed conditions (in terms of dimensions and safety, sanitary-hygienic conditions, fire protection conditions, installation and technical conditions, etc.) in order to conduct sports activities in them (Krsmanović Veličković, 2021).

Kaminsky (2013) states that physical fitness is a set of characteristics of an individual, the level of which is directly related to taking part in some kind of physical activity and that quality training process is of utmost importance for physical fitness. Instruments and certain equipment can be used to determine abilities, but these kinds of monitoring and measuring must be conducted extremely precisely. In order to declare a training process successful, it is necessary to include diagnosis, prognosis, training program and control, so it is vital to use methods and measuring instruments used to measure and control the dominant anthropological characteristics, according to Ćopić (2020). In the modern era, it is required to systematically monitor the relevant indicators of body composition several times a year, in some cases even up to two times a week, whereas it used to be done once to twice a year.

Besides employing qualified staff which will deal with the training process and examinations, there is also the staff that will do some other tasks, such as maintaining the diagnostic center. The potentially increased flow of people through the space calls for zoning the space very well and determining functional units properly. The medical section where consultations and examinations will take place must be a separate unit, then there is the section for therapies, the section for measuring instruments and exercise, changing rooms with toilets, and waiting rooms as needed, etc. If there is need for a waiting room, its dimensions are determined according to the number and frequency of the surrounding rooms, as well as the professional orientation of the engaged doctor. There should certainly be a reception area at the entrance to the center, as well as toilets and changing rooms for storing personal belongings.
Interior Furnishing and Design

Functional diagnostics has advanced and with each day it brings more precise and better results, consequently it requires new technologies and adapting the space to its needs, too. Functionality plays a great role in furnishing and designing the interior spaces that serve the purpose of these centers.

It is necessary to fulfill a whole range of factors in order to give any space a feeling of warmth and comfort, and certainly one of these factors are the colours that will be used in the space in project. We could call colours the “forces” that affect a man in a certain psychological way and they can cause feelings of pleasure or discomfort, i.e. they can trigger more active or passive feelings. The impact of colours on human psyche can be indirect (physiological impact, they visually narrow or widen the space) or direct (manifested in impulses coming from so-called warm (yellow, red, green) or cold (blue, purple) colours), and the size of the space is very important for the choice of colours.

A good choice of floor covering affects the overall impression about the space, maintenance costs and the value of the space itself. The floor is a constructional part of the building which bears the greatest load and at the beginning of the construction it is always necessary to determine how insulation and sealing will be done, and all that in accordance with the general purpose of the space.

Lighting is very important in a space, it can be a sort of decoration and it can be categorized as: narrow beam, medium beam and wide beam lighting, but also as symmetrical and asymmetrical lighting. For interior lighting, incandescent light bulbs (warm white light, no flickering) or discharge lamps (requiring two devices – a ballast and a starter, with high light efficiency) are most commonly used. Direct symmetrical lighting, as well as indirect lighting is most commonly used in diagnostic centers.

Medical Section within a Diagnostic Center

When designing an interior, it is most popular to arrange separate offices, such as those for general practitioners and certain specialists. The main problems that interior designers encounter when arranging such spaces are: insufficient waiting room space in front of the office, simple and minimalist design, inadequate space for setting up an office (e.g. on the first floor of someone’s house, etc.)... That is why a structural change is crucial to carefully design every corner and to give purpose to each piece of furniture and equipment.
The examination area should have at least six square meters, it should be optically and acoustically closed, and its purpose is to have anamneses, counseling, result analysis, therapy plans and protocols conducted in it. These spaces are designed differently depending on whether the patients can stand or need lying down, because the minimum equipment in them is a rotating chair or a patient bed, an instrument table and a desk, and a chair for the doctor, too. The bigger the spaces are, the more their design is determined by the necessary professionally specific instruments, equipment, the necessary radius of movement for the staff, but also the need for a screen behind which the patients can change clothes.

Figure 2 shows the appearance of the examination space for lying patients which should have at least six square meters, an examination table and a chair, and if possible, a side table for placing certain instruments. It is always advised that these spaces have a screen behind which patients can change clothes.

**Figure 2:** The appearance of the examination area for lying patients

![Figure 2: The appearance of the examination area for lying patients](image)


**Laboratory within the Diagnostic Center**

The spaces designated for laboratories mainly serve for the analysis of blood, urine and stool samples of athletes. In modern diagnostic centers today, they are mandatory, whereas earlier it was not the case. In order to diagnose certain conditions more easily and maintain practicality in work with athletes, they have become a
necessary condition for the operation of diagnostic centers. These spaces are usually big with working surfaces flexibly distributed and they include standing workstations for employees. Special rooms alongside laboratories may include: staffrooms, washing and drainage areas, disinfection rooms, cold rooms, etc. All spaces serving these needs need to have certain ceiling height (the minimum of three meters), natural and artificial light, ventilation, but they also need to form zones with different purposes and technical qualities. Typically, the buildings that will have a laboratory in them must be built with attention to horizontal water installations, and installation floors for technical facilities are located in the basement or attic. Obviously, reinforced concrete skeleton is something necessary when building such objects, as well as the floor covering which must be waterproof and chemical-resistant, it must not have joints and great care must be taken with electrical conductors which need to be installed according to the safest standards.

Laboratories can be divided according to their use into educational laboratories which are very simply equipped, and research laboratories which are smaller in dimensions, but have special equipment (measuring instruments, etc.). When we take their field of work into consideration, laboratories can be divided into: chemical and biological laboratories with built-in equipment (such as desks) and physical laboratories. The former have a high level of air exchange, while the latter have a lower level of it.

On Figure 3 we can see the minimum space required for an electrocardiogram, which would be around 6.5 square meters because the room must contain a bed for the examinee, as well as a chair and a table with the instrument for the doctor performing the examination. Figure 4 depicts the minimum space of the room in which blood samples are taken and which should be around six square meters. In that room, there must be tables for equipment and samples, a rotating chair for the laboratory assistant and a separate armchair for the examinee to sit while their blood is being drawn. Such armchairs usually have the option to expand the leg rest and to recline to a lying position, too.
If the plan and purpose of a diagnostic center includes an adaptable multi-purpose laboratory, it needs to be constructed according to certain standards which are legally and architecturally prescribed. In Figure 5 we can see an example of a typical layout of such an adaptable multi-purpose laboratory, the area of which should be over 20 square meters.

**Figure 5:** Multi-purpose laboratory

Figure 6 illustrates the minimum width of the passages beside workstations in laboratory conditions and it is 140 centimeters for two people (if each person works at their own table) and 355 centimeters for three people (if two people work at the table and the third one passes between them).

**Figure 6:** Passage between workstations

![Figure 6: Passage between workstations](image)


Figure 7 shows the so-called cross-section of the laboratory with an appropriately positioned corridor where we can see the ground floor, basement and utility corridor for specific needs.

**Figure 7:** Cross-section of the laboratory with a representation of the ground floor and basement

![Figure 7: Cross-section of the laboratory](image)

Diagnostics and Training Area of the Diagnostic Center

The essence of sports diagnostics is the use of special procedures and tools necessary for the proper control of an athlete’s training process. This refers to the assessment of an athlete’s body’s reaction to training stimuli, i.e. measuring training effects (the current effect (acute responses)), and the accumulation of multiple trainings, e.g. the long-term effect (chronic responses). Comprehensive measurements require a combination of methods that will ensure an assessment of the level of individual motor abilities and it is all performed without disrupting motor structures (Travis S.K., 2020). To sum up, comprehensive measurements can reliably diagnose the body’s metabolic, motor and technical potential.

Scientists dealing with computer sciences and engineers working with biomechanics, physiologists, engineers, sports psychologists and coaches, are involved in interdisciplinary development systems, so coaches and athletes are offered innovative and most efficient support when identifying and analyzing a patient’s results (an examinee or an athlete). A different set of sensors and devices used in diagnostic centers can be integrated into sports equipment or even attached to athletes. Computers collect and present the recorded data and other systems use telemetry methods for transmitting the gathered data to reception stations which, then, process them and present them adequately. Portable devices not restricted to laboratory conditions are especially useful in sports like rowing, table tennis and biathlon, concludes Vasa (2006). All the programs have so far given good results and the conclusion is that they function well when used. The users are able to understand the presented information, and measuring devices do not limit movement in any way. Real-time feedback is obtained fast and at the same time biomechanic data specific to certain sports are collected and analyzed. Special attention is paid to the design of the presentation component of the system, with the greatest focus on its modernization. (Mackala, Michalik, Makaruk, 2023).

Here are some approaches that can be used in testing: symmetry and functional asymmetry, dynamic module of motor skills, measuring muscle strength, measuring peak strength, peak power and lactate concentration, the kinematics of running, as well as measuring muscle and tendon stiffness and flexibility (Roberts, 2016). Thanks to more precise and faster sampling nowadays, it is becoming easier to collect data during static measurements, dynamic monitoring, movement and performance. These tests are a huge load on an examinee’s body, so several conditions must be met in order to conduct such an examination in a laboratory. It is important that the examinee is willing to participate in the examination, that they are as healthy as they can be and that they wear light sportswear. Proper load tests provide the most
accurate data on a person’s current condition. These tests are appropriate for precise demonstration of the examinee’s physiological parameters (heart rate, blood pressure, ECG, etc.), together with measuring the aerobic or relative aerobic capacity and physical performances of an examinee. Load test really requires excellent performances by an examinee and that can be achieved by activating at least 50% of total muscle mass during exercise. The actions monitored are running, bicycle riding and rowing. For that reason treadmill ergometers, cycling ergometers and rowing ergometers are usually used (Balogh, 2016).

Nowadays there are multiple different methods and instruments for measurement, that is, analysis of body composition (e.g. InBody720-Biospace Co.; Tanita-BC 545, etc.) that can be used in diagnostic centers as quite useful machines. Such machines work on the principle of passing low power current that goes through muscles without any resistance and through fatty tissue with low resistance.

**Figure 8: InBody720**

![InBody720]

*Source: https://inbodyusa.com/products/inbody770/*

It is vital to list some of the equipment that is obligatory in the training areas of diagnostic centers, and these are free weights, props, as well as training machines. Training machines are an especially important group because they are beneficial in multiple ways, according to Petronijević, 2023. They can be grouped into:

- **Cyclic machines** – they serve for warm-up and increasing aerobic and anaerobic endurance (bicycle: spin-bike, ergometer or recumbent bike; treadmill; stepper; elliptical trainer and rowing simulator);
- **Machines for arms, shoulders and chest** include: biceps machine, triceps machine, forearm extension machine and forearm muscle strengthening machine.

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- Machines for shoulders and legs include: leg press, leg extension machine, hip joint flexor, hip and leg muscle strengthening machine, gluteal region and hack squat machine.
- Multifunctional machines (very large devices that are also called basic machines that cover all muscle regions).

In order to have enough room for 40 to 45 people to train in, the size of the space needs to be at least 200 square meters, and ceiling height needs to be at least three meters. In the following figure, we can see two-cell setups of equipment, and the conditioning and preparation areas should not be less than six meters wide. When considering the minimum space for training, it should have 40 square meters, allowing 12 people to exercise simultaneously. In Figure 9 a room for conditioning exercise is shown with the following necessary equipment for the purpose: hand roller, biceps and triceps station, “pull/over” machines, machines for strengthening the back muscles, chest, trunk, hips, bones, feet, as well as the multi-exercise center. There are machines for pressing, knee bending, pulling and climbing, benches, various racks, training benches, weight discs and weights, bars, rowing machines, treadmills, a boxing pear and cabinets for storing the equipment, too.

**Figure 9:** An example of furnishing the room for conditional training of the size of around 200 square meters

In Figure 10, we can see an example of an exercising room of 200 square meters in dimensions. A large part equipment is doubled in number, there are hand rollers, biceps and triceps stations, “pull/over” machines, machines for strengthening the back muscles, chest, trunk, hips, bones, feet. Along with all this, there is a popular multi-exercise center, a pulling machine, a training bench, storage racks for weights of different sizes, various benches, a treadmill, an exercise machine, etc. This set of exercising machines is standard in almost all centers.

![Figure 10: An example of an exercising space of 200 square meters](image)


When it comes to making the arrangement for all of the above-mentioned equipment, one should pay attention to the dimensions of each piece of equipment that we want in a space, its weight, width, but also height. For example, a rowing machine and a stationary bike require a lot of space (Figure 10) and the spot where they will be placed needs to be picked carefully. A rowing machine requires a minimum space of 1.5 square meters, and a stationary bike requires a bit less – about half a square meter.

In Figure 11, we can see an abdominal bench with an adjustable inclined board and wall bars, which takes up around two square meters. A specific area which most often occupies the most space is the so-called multi-exercise center (Figure 12), and it takes over two square meters of space.
Conclusion

In order to continue with the development of sports in the Republic of Serbia, a complete revision and then a planned reconstruction and building of sports objects is imperative. The strategic plan has always been to revitalize the existing sports objects and additional facilities wherever that is possible and appropriate, and then to
build new objects. Modern and functionally organized infrastructure of sports objects is one of the key preconditions for achieving development and success in all fields (Krsmanović Veličković, 2021).

Sports diagnostics is a comprehensive scientific concept that encompasses the aspect of training monitoring and/or sports medicine. In many cases, that is quite challenging in the real world of sports especially in the professional sphere (Mercer et al., 2022). This level of control allows for managing fatigue and protects athletes from the excessive risk of injury during an intensive sports training (West S.W. et al., 2021). One of the main goals of sports diagnostics is maintaining health because a regular training process is possible thanks to it. The things that the training process can least influence are the ability to engage in sports, but also the overall health without injuries after the training is complete (Dijkstra H.P. et al., 2014). Maintaining health enables us to break down physical barriers and perform more complex and longer efforts.

Sports diagnostics is closely connected to training monitoring (external and internal loads). Therefore, it can be an interesting addition and it can contribute to knowledge about athletes and their adaptations to training. Scientist should be able to answer even the hardest questions of coaches, and, on the other hand, coaches should rely on their experience and the latest knowledge.

Taking everything into consideration, it is extremely important how diagnostic centers will be equipped and designed so as to completely fit the measures of a properly developed person, as well as the space required for different positions and movements. Having in mind that a man is not only a being that needs space, special attention needs to be paid to experience of the space itself, that is, how a space is dimensioned, divided, coloured, lit, what kind of furniture is in it, and these are just some of the most important things influencing the behaviour and mood of people in a space.

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