

## **PROGRAM DESIGN:**

### **CONSTRUCTING TRAINING PROGRAMS - PART II**

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*Prof. Spassov originally wrote the following article in 1988 and it was published in NSCA Journal. Volume 10, Number 4, 1988. The statistics and theories still apply today.*

The most important point about the training of the best athletes in Europe (former Soviet Union, former East Germany, Poland, Hungary, Romania, Bulgaria, former Czechoslovakia, Italy, Finland, former West Germany, Spain, Austria, former Yugoslavia) and China of recent years is the general approach in planning the training. The planning is designed in patterns of four years in advance (within an Olympic cycle), annual, monthly and weekly plans. The plans four years in advance and the annual plans are of a general nature, and are connected mainly with the sport result, while the basic outlines of training are included in the so-called operative plans within the scope of a week or a month.

Annual training plans are generally based on two or three macrocycles depending on the number of the most important competitions for the year. These two or three macrocycles are divided in mesocycles, the number of which depends on the macrocycle. A mesocycle usually consists of four weeks or a month, within the scope of which each week (microcycle) has its special function.

The first week is called "week of introduction" and has the function of providing the female athlete with the opportunity to adapt herself to the new training load. She is given the opportunity to get exhaustive information about the nature of exercises, the volume and intensity of the training load. The volume reaches up to 80 to 90 percent of the maximum for the mesocycle, and the intensity up to 90 to 100 percent.

The second week is called "basic week" and is intended for the largest volume of work, which is to enlarge the physiological abilities of women athletes. Here, as it can be expected, the volume reaches its maximal value for the mesocycle, while the intensity, due to the great fatigue decreases to 85 to 90 percent.

The third week is of an accelerated rate, hence it is called "intensive" (or shock) week. The volume decreases to 80 to 85 percent of that of the basic week; the intensity, however, is increased up to the maximal limit through incessant effort to find the maximum of result in each exercise and training. It will be only natural that they are not expected to demonstrate the same result throughout their training nor are standards to increase incessantly. However, one should aim at getting the maximum out of each exercise and each training.

The fourth week is called "test week," During this week the volume drops down to 60 to 65 percent of the maximal in the basic week, and the intensity of the basic competitive exercises gradually decreases toward the end of the week. On the fifth or sixth day in this week, a test is held under competition conditions, if possible, and athletes are expected to demonstrate the maximum they have reached in the basic event.

Thus by the end of the mesocycle it becomes possible to define the precise level which the female athlete has reached; and the level of the sport result can provide a basis for assessing the effectiveness of the training methods. And, when this is coupled with the necessary medical tests, it becomes possible to find out both the advantages and disadvantages of the chosen training methods and their application in the microcycle. A major advantage in this case is that one can detect the shortcomings of the training process every month, and, hence, do away with them.

Provided that the results are becoming better and things go well and smoothly, the chosen methods and technique can be defined as successful, while attention could be concentrated on their improvement.

It should also be added here that there are no days off in between the four weeks comprising the mesocycle, and trainings are held on Sundays as well for about 45 to 60 minutes. There is a day off at the end of the mesocycle which falls on the second day after the test (it should not be placed immediately after the test). Our experiments and practice, as well as the opinions of most authors, lead to the conclusion that it is more sensible to have a training of an average volume and low intensity on the day after the test instead of having a rest.

To summarize: we think that the basic advantages of planning the training in mesocycles lie in the opportunity for operative control over the training process, for a clear perspective of the athletes at any time of the training, as well as an opportunity for current correction and control over the condition in view of the major competitions.

Such a training approach demands consistent physical preparation by women athletes. This means no long intermissions for rest during the annual and the years-in-advance training cycle. Even after major events, rest should not take longer than one or two weeks, since a lot of time will be wasted getting back in good shape later instead of starting from the level that has already been reached. Naturally, such an approach cuts short the competitive life of women athletes due to the great physical and psychological exhaustion. Nowadays, most women can take part in international events within the scope of just one Olympic cycle (rarely two). We should not think that this is a wrong tendency, since sport results have increased recently to such an extent that there seems no other way to reach the top. People who insist on having a long sporting career should be content with average results. Of course, there have been exceptions, mainly in the team sports, since the volume and intensity of load there is far less than those in individual sports.

### **1. On some basic problems of constructing training programs in weightlifting.**

As noted previously, the week is the basic unit in training planning, since it presents the most concrete form of planning all training techniques and their volume and intensity. Before actually mapping out the weekly plan, we must clarify a few basic points that determine the nature of planning.

First comes the question of how many times a week we have to train for strength build-up. Of course, this will depend mainly on some subjective factors such as time (both the trainer's and the athlete's), for example. However, we choose to concentrate on the general objective factors here.

It is well known that when training for strength build-up, the interval between two trainings should not be longer than 72 hours, since a larger interval will lead to the decomposition of strength skills. From this point of view, strength is that physical skill which can be built up most quickly and to the highest degree; and at the same time it can be lost at the same rate. Consequently, we can say that we should have no less than three training sessions a week.

Having defined the minimum number of training sessions a week, let us try and see how many training sessions at the most we can have a week.

From works in physiology we know that strength is best trained if women athletes consume their training load in five sessions a day. Consequently, the maximum number of trainings per week can be 35! Of course, this is only a theoretical estimation. It has not happened in practice, however, except for certain experiments. However, in some countries athletes whose results depend mainly on strength have reached up to 20 and more strength training sessions per week.

This raises a number of questions, the major one being the concern of the government about those people, ensuring their time for training, as well as their recreation, medical care and nutrition. However, we consider it our task as specialists to define what is essential in terms of methodology, the rest being a matter of organization. After all, we could say that 35 trainings a week at the present moment would seem an absurd training load, but so would the training limits of a contemporary champion 50 or 60 years ago.

The next problem is, how long should a single training session last? As a rule, it is limited by the time we can afford; however, we would like to examine it from the point of view of the physiological abilities of the human body to ensure a basis for highly effective effort.

Recently, some authors have pointed out that the planning of training should take into consideration the level of testosterone in blood. It is known that the level of testosterone increases after the beginning of physical activity up to 20 minutes and, having reached its maximal value, it preserves that level up to 42 to 45 minutes. Then it begins to drop, and this process is particularly intense by the end of the first hour of work. It has already become clear that a single strength training session should not last more than an hour.

An interesting experiment was carried out in Bulgaria. Groups of teenagers training in weightlifting were tested in 30 m and 60 m sprint, standing high jump, standing long jump and standing hop-skip-and-jump. In the course of two years, half of the groups were trained according to the traditional training methods – the first year including 80 percent general physical instruction, the second. 60 percent. Naturally, the rest of the training time was filled by barbell exercises.

The other half started exclusively with bar training from the very beginning, but training time was 45 minutes, whereas training time for the other groups varied between 60 and 90 minutes. At the end of the two-year training course, the groups which had had 45-minute training exercise twice a day demonstrated better results than those who had had 60 and 90 minute training. They were better, not only at weightlifting, but at sprint and jumps as well, although they had never practiced them!

This illustrates that raising the cultural standard of training is the most important factor for the advancement of sport achievements at the present stage.

We may also add that the effect of a 45 to 60 minute training with a 20 to 30 minute break is much larger than that of an uninterrupted training process of two and a half hours. Naturally, it would be better if the break is longer, but 20 minutes is the minimum.

Quite a few specialists are still considering the problem of the role of strength training in combination with the other training methods in cases when women athletes do not practice weightlifting exclusively, and strength exercises are just supplementary. We would say, in brief, that during the introduction and the basic weeks, the strength training comes after technique and velocity exercises for the basic event. Let us take swimming as an example. Technique and velocity exercises in the pool are followed by strength exercises, and then 800 m freestyle. The volume of strength training decreases during the shock week, but strength exercises are performed before the technique and velocity ones. During the test week, strength exercises decrease in volume and intensity; they are performed every other day after the technique and velocity exercises.

The selection of training exercises is of special importance for the successful build-up of strength. Generally speaking there is a tendency for decreasing their number. About 30 years ago the general methodology of sport training stated that a wide variety of training exercises is a trademark of a sound basis for future trainings. However, it has gradually become clear that not all exercises have an equally useful effect on the cultivation of that skill. Therefore, specialists

have dropped the exercises with no effect. In the '50s, weightlifters would include 25 to 28 training exercises in their weekly program; at the beginning of the '70s their number was 15 to 17, whereas at the present time there are only six to eight exercises. It is well known that this has proven harmless for the advance of sport result. In fact, the level of records has increased many times.

Training techniques oriented toward the building up of strength are of a wide variety, and each of them should find its place in the methodology of instruction. The most versatile among them is the wide application of the barbell. In many cases successful attempts have been made to substitute it with other apparatus over a certain period of time, but in most of the cases the barbell is simply a must. If we add up its simplicity, versatility and low cost, it becomes clear that we cannot speak about strength training without the bar. Throughout this article, speaking of weights and loads, we will have in mind primarily barbell exercises.

When it comes to specifying training loads, volume and intensity are the major elements.

Strength training (if compared to endurance) was oriented toward increasing the volume of training load with a considerable delay. This tendency became clear at the end of the '50s and reached its culmination at the turn of the '70s when weightlifters reached a volume of 30 to 40 tons a day. Some reached up to 50 to 60, while on particular shock days some athletes lifted 80 or even 100 tons. The idea was that when the volume decreased, an athlete who had rested would be able to achieve better results. That is exactly what happened in practice, too – the load would be decreased two or three weeks before the contest took place and the athlete achieved far better results than his personal record.

We should not underestimate the fact that the use of steroids at the time was allowed, and their use made it possible for such a volume of work to be done. Such an amount of work would exhaust the hormone system of the body and, without additional steroid hormones, the recreation period would be extremely prolonged.

It is well known that in 1976 the use of the above hormones was prohibited by the International Olympic Committee, and specialists had to seek new means. For that reason, new ways were sought to improve the training process through the resources of the other training load factor – intensity. Intensity has also undergone several phases of development. It was usually considered that maximum weight would be lifted only at contests. Attempts at weight lifting with maximum exertion during training were introduced by Egyptian athletes in the '30s and the '40s. They happened to employ this technique by chance and without previous research. Later, athletes from other countries made attempts with maximum exertion during training as well. In the '50s, the weekly load of an athlete would include six to 10 attempts with maximum exertion; in the '60s, 12 to 17; in the '70s, 17 to 24; whereas at present the number of maximum exertion attempts during the training process of weight lifters varies from 25 to 30 a day.

This leads us to the conclusion that despite the decreased volume, which varies from eight to 15 tons a day for the different categories, the increase of intensity plays a major role for the advance of sport result.

The optimum combination of volume and intensity as well as competitive and assistant exercises determines the quality of strength building training activities. In 1980, Bulgaria introduced the following formula for training evaluation:

$$Q=c(V/NL)$$

In this formula Q is the quality of training, V the volume (tonnage), NL = the number of lifts, c = coefficient of the ratio between assistant and competitive exercise in percent. Let us assume that the volume of a given training session is 10 tons, the number of lifts (NL) = 100, and the

percentage of competitive exercises compared to the whole volume of exercise is 50 percent. For the purpose of convenience, let us turn 100 percent into one (1). Hence, the coefficient in our example will be 0.5 ( $c=0.5$ ). If we substitute it in the formula, then  $Q = 0.5(10.000 \text{ kg} / 100)$  or  $Q=50$ ; that is, the quality of a single training session numerically expressed will be 50 units. We must say that the indices of high quality are 80 and more units, so that in our example we illustrate a training of an average quality.

To exhaust the problems connected with the general prerequisites for strength training, we have to discuss the number of repetitions and the number of sets for a given exercise during a single training. It will naturally depend on the kind of strength we are trying to build, hence we will examine each type separately.

When building maximal strength, the number of repetitions varies from one to three, with maximal and sub-maximal weights. We should have in mind the maximum possibilities within a particular training and not in general, since this is the only way of conducting a scientific highly efficient training. That is why we should reach our maximum for the basic training exercise within each single training.

When training for velocity, strength and explosive power, the number of repetitions should be the maximum performed in 10 seconds and with maximal velocity. Here it becomes necessary to specify the possibilities of performing this series with different degrees of resistance, since weight varies from 25 to 75 percent of the maximum.

The training for strength endurance is more complex, for it requires a more complex setting up of the training resistance. First, one should find out what the strength required for each effort in the basic training event is; for example, the force with which a swimmer strikes the water, a cyclist presses on the pedals or a sprinter hits the racing track. Then a weight of 105 to 110 percent of the competitive effort is put on the bar and repetitions are made until their number reaches 105 to 110 percent of the actual number of repetitions when covering the racing distance. In some events, this will not happen at one go, but a guiding principle for us should be that a single training should not exceed an hour (45 minutes is still better) with three to six sets, the pulse at the beginning of each set being 108 to 114.

## **2. Kinds of strength and means of development**

Depending on the regime of muscle contractions, strength can be dynamic or static.

In the dynamic regime, the strength of the active muscles is manifested through their shortening (overcoming nature of the work) or through their lengthening (receding nature of the work).

In the static regime, muscle strength is manifested through the "active" or "passive" tension for the participating muscles.

Maximal strength is the strength which the muscles develop in contraction when they are no longer able to lift the weight. It is also called "absolute strength."

The maximal dynamic strength of a muscle is a function of its length in the moment of contraction, the speed of contraction and the time which is necessary to reach the maximal tension.

Since acceleration takes place only at the beginning of the motion when overcoming up-to-a-limit resistance, the velocity of transfer of the resistance is constant during the greater part of the motion. Therefore, its value is approximately equal to the resistance to be overcome.

The maximal strength is demonstrated in receding regime (eccentric) work but never in both overcoming (concentric) and receding regime, since in a receding regime resistance is one and a half to two times higher than in an overcoming regime. For this reason, we should create conditions for training in receding regime in order to develop maximal strength.

One of the peculiarities of the mechanism of muscle contraction when maximal strength is concerned refers to the synchronization of the greatest number of muscle fibers having the highest rate of tension and the maximum frequency of effective impulses.

The duration of the up-to-the-limit tension is the biggest in maximal strength compared to that in all other kinds of dynamic strength. It is assumed that the longer the up-to-the-limit tension is, the greater the synchronization of the muscle fibers would be.

In maximal strength, the antagonist muscles are in optimal tension, while the maximum chemical energy per time unit occurs when the up-to-the-limit weight is detached from the point of support. It is most probable that at this moment the maximal decomposition of the adenosine triphosphate and the creatin phosphate takes place. In order to hold back the velocity of motion of resistance, a speedy recovery of energy is required. The holding back of the velocity of the motion will depend on the speed of influx of ATP. When maximal strength is demonstrated, the amount of myosin and its ferment activity will undoubtedly have a considerable significance for increasing the decomposition rate of ATP at maximal mobilization.

The development of maximal strength is possible in round-the-limit, up-to-the-limit and over-the-limit muscular efforts. When talking about general recommendations, as is the case, the value of resistance would be generally defined in terms of percents of the maximum result. In Bulgaria, for various reasons, it is no longer in use, and training programs fix weights in terms of the difference in kg from the maximum result. So, for example, if the maximum result in a given exercise is 100 kg and there are two sets of two repetitions at 90 kg to be performed, the way of presenting it will be 2x2x –10 kg (minus 10 kg) instead of 2x2x90%. In this case the first digit represents the number of sets (attempts), while the second is the number of repetitions in a single set.

Let us now examine a four-week training mesocycle comprised of an introduction, basic, shock and test week. We will mainly refer to intensity problems here, since the volume will depend on individual abilities, training time, recreation and a variety of other factors which may vary in different countries. In all equations the last figure represents the percent of 1 RM: the second figure the number of repetitions.

**First week** – Introduction: Low Intensity

5x70 kg; 3x80 kg; 2x1x90 kg; 3x3x80 kg; 10x70 kg

**Second week** – Basic: Average Intensity

5x70 kg; 3x80 kg; 2x90 kg; 2x1x100 kg; 3x2x90 kg; 3x5x80 kg

**Third week** – Shock: Great Intensity

3x70 kg; 2x80 kg; 2x90 kg; 3x1x100 kg; 3x2x90-95 kg; 1x95 kg; 2x1x100 kg; 2x3x85 kg; 1x90 kg; 1-2x1x100 kg

**Fourth week** – Test: Low Intensity

2x70 kg; 1x80 kg; 1x85 kg; 2x80 kg; 3x2x70 kg

In this case, we assume that the maximum possibilities in a given exercise are 100 kg, and the attempts are denoted by their value in kg. However, it is known that at the end of each mesocycle the possibilities will change and the change in our program will be denoted by the weight subtracted from the maximum. For example:

**First week** – Introduction: Low Intensity

5x-30 kg; 3x-20 kg; 2x1x-10 kg; 3x3x-20; 10x-30

It now becomes clear that this pattern can be used to map out the program for the rest of the weeks for each athlete attempting to develop maximal strength.

Explosive power is the overcoming of particular, below the maximum resistance with maximal velocity. Depending on the value of resistance, various values of maximal dynamic strength can be reached. When overcoming up-to-the-limit resistance, which ensures the development of velocity, the maximal strength reaches its absolute dynamic strength values. Explosive power is demonstrated in the overcoming nature of muscle activity. Typical examples are the throws in track and field events – the discus, the javelin, the hammer and putting the shot. As we have pointed out, the greatest power demonstrated by man has been measured in horsepower when putting the shot.

The Bulgarian method for developing explosive power is based on the so-called contrasting method. Here is an example to illustrate this method:

### **Back Squat**

3x-30; 2x-20; 2x-10; 3x1xMax; 3x2x –10 (developing maximal strength)

3-6 x 10 sec x –30 (we aim at the maximum repetitions per 10 seconds)

3-6 x 10 sec. x 25% (a quarter of the maximum – developing power)

3-6 x 10 sec (standing high jumps at a maximum height - without weight)

In this case the idea is to decrease the resistance to and gradually increase the velocity of performance.

Our experience has proven that this is the quickest -as well as the most effective method from among all methods for developing explosive power.

Quick power is the ability of muscles to demonstrate maximal motion velocity at optimal resistance. Typical examples are sprints and jumps in track and field events, elements from games, boxing etc. In a single motion, the single power (resistance is the same) is lower in value than the explosive power at the same resistance. The application of quick power in sport is, having reached a definite standard of the efforts in a given exercise, to try and keep up the required time. If we take sprints for example (without the start and the finish), we will be able to trace similar efforts during the race. In gymnastics and acrobatics, motions should be defined in terms of strength, velocity, amplitude etc.

The developing of quick power is carried out at 60 to 75 percent of the maximal possibilities of an exercise in three to six sets, in each of which we aim at achieving the maximum number of repetitions at the maximal velocity. At that, the resistance for each series should be changed. For example:

### **First week - Introduction: Low Intensity**

Max @ - 40; Max @ - 35; Max@ - 30; Max @ - 25; Max@-35; Max@- 30

### **First week – Introduction: Low Intensity**

5x70 kg; 3x80 kg; 2x1x90 kg; 3x3x80 kg; 10x70 kg

### **Second week – Basic: Average Intensity**

5x70 kg; 3x80 kg; 2x90 kg; 2x1x100 kg; 3x2x90 kg; 3x5x80 kg

### **Third week – Shock: Great Intensity**

3x70 kg; 2x80 kg; 2x90 kg; 3x1x100 kg; 3x2x90-95 kg; 1x95 kg; 2x1x100 kg; 2x3x85 kg; 1x90 kg; 1-2x1x100 kg

### **Fourth week – Test: Low Intensity**

2x70 kg; 1x80 kg; 1x85 kg; 2x80 kg; 3x2x70 kg

In this case, we assume that the maximum possibilities in a given exercise are 100 kg, and the attempts are denoted by their value in kg. However, it is known that at the end of each mesocycle the possibilities will change and the change in our program will be denoted by the weight subtracted from the maximum. For example:

First week – Introduction: Low Intensity

5x-30 kg; 3x-20 kg; 2x1x-10 kg; 3x3x-20; 10x-30

It now becomes clear that this pattern can be used to map out the program for the rest of the weeks for each athlete attempting to develop maximal strength.

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The developing of quick power is carried out at 60 to 75 percent of the maximal possibilities of an exercise in three to six sets, in each of which we aim at achieving the maximum number of repetitions at the maximal velocity. At that, the resistance for each series should be changed. For example:

First week—introduction: low intensity

Max @ - 40; Max @ - 35; Max@ - 30; Max @ - 25; Max@-35; Max@- 30

This is an example of a particular exercise in six sets in each of which the resistance changes, and what is preserved is the effort to maintain a maximal velocity.

Endurance is the ability of the muscle to repeatedly overcome average resistance. Endurance is especially important in wrestling, rowing, boxing, sport games, etc. Recently, even long distance runners and marathon runners have grown interested in strength endurance. The difficulty in building up endurance for these athletes lies in the fact that their muscles must increase only in strength and not in mass. That is why strength exercises in such cases should be close in volume and velocity of effort to the competitive event itself. We can use an example to illustrate this: if a marathon runner takes 25,000 paces on the average, and with each pace exerts a pressure of .50 kg over the support, he should conduct his strength training with the same effort and repetition. Naturally, in order to achieve better quality, they should exceed slightly the effort at contest time, but not more than 105 to 110 percent. So, the marathon runner should train three to four times a week for about 45 to 50 minutes with three to six sets of selected exercises, in which the number of repetitions will depend on individual abilities and the type of exercise, and the coach's considerations about maximum resemblance with competitive effort.

Static strength is of interest to sport specialists mainly because in the course of training this particular kind of strength, the amount of structural protein is increased to the greatest extent.

The physiological mechanism of the demonstration of maximal static strength is tetanic contraction which is formed as a result of the overlapping of elementary tension waves on each nervous impulse. Static strength training usually enhances the building of maximal strength and is hence applied to the instruction of athletes who need it.

Having outlined the basic points about the building of the different types of strength, we can make a weekly training program for different sports requiring different types of strength. (See Figure 1).

This is a general orientation program. The duration of each single training is 45 minutes. Some sports need different kinds of strength; however, the most important point is to define the basic kind and consequently place the kind of sport in the right group. Of course, it is advisable to seek the right combination of variants within the other groups in which this particular sport happens to fall. The above mentioned program is just provisional and provides us with a general idea to what extent each kind of strength should be included in the program and maintain its prevailing character in combination with the degree of necessary use of other kinds of strength.

Undoubtedly, strength training is the basis of contemporary sport training, with its favorable effect on the development of nearly all physical qualities – velocity, endurance, skill.

Despite all recommendations, strength instruction is strictly individual, and its successful application depends greatly on the abilities and qualification of the coach, who is the one to adapt strength training programs to each athlete in such a way as to develop her individual abilities to the highest degree.

**Figure 1 - Sport-specific Weekly Training Program**

Kinds of sports & strength	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
<b>1. MAXIMAL STRENGTH</b> - weight lifting, bob-sled, throws, wrestling, football, power lifting, acrobatics, jumps, judo etc.	Maximal strength and quick strength	Maximal strength and explosive power	Maximal strength and quick power	Quick power and explosive power	Maximal Strength	Maximal Strength	Rest
<b>2. EXPLOSIVE POWER</b> - throws, jumps sprints, games, down hill skiing, ski jump, diving, etc.	Explosive power and quick power	Quick power and explosive strength	Explosive power	Quick power	Explosive power and maximal strength	Maximal strength and explosive power	Rest
<b>3. ENDURANCE</b> - swimming, racing, rowing, wrestling, fencing, ski	Endurance	Quick power and endurance	Explosive power	Endurance	Maximal strength and endurance	Endurance	Rest

racing, cycling, etc							
<b>4. QUICK POWER</b> - gymnastics, rowing, acrobatics, etc	Quick power	Explosive power	Maximal strength	Quick power	Explosive power	Quick power	Rest
<b>5. STATIC STRENGTH</b> - acrobatics, gymnastics, downhill skiing, swimming, figure skating, etc	Static strength and quick power	Static strength and explosive power	Maximal strength	Static power and maximal strength	Quick power and explosive power	Static strength and quick power	Rest