

# INTEGRATED GUIDE FOR MANAGEMENT OF URBAN GREEN SPACE

## IN HASKOVO

### ABSTRACT

The guide contains the basic requirements that characterize and cover the compliance of technologies to maintain the structural elements of the green spaces. For each structural element there are defined requirements that ensure proper implementation of the technology. The technological requirements apply to both inputs and for the work to be performed in the maintenance of green spaces. When properly applied in practice of these requirements, the main structural elements should be in good quality, and green spaces - in optimum condition.

The purpose of this paper is to be used by municipal officials and employees of the Municipal company "Eco - progress" engaged in activities in landscaping and performing investment activities as well as by private companies involved in maintenance, in contracting and implementation of activities related to planting and landscaping.

Part I. Technological requirements for maintaining the structural elements of the green spaces

#### **I. General Terms**

The functions of vegetation in urban spaces differ in nature. In most cases they are determined by the environment and are inter-connected. The functions of the park vegetation are engineering, environmental and aesthetic.

These functions are related to the construction of green areas as pure aesthetic structures without underestimating the fact that they contribute to functional facilities.

According to the intensity of maintenance the lawns which are municipal property in the country are divided into the following categories for maintenance for municipal sites or their parts as follows:

Category I - a representative maintenance. These are limited in size, park-landscaped sites of national or municipal significance, or any part thereof in representative urban areas.

Category II - with optimal maintenance - for park landscaped sites or parts of them, with a large area of municipal importance in the central urban areas, sites or parts thereof not covered by the previous category.

Category III – with average maintenance for the majority of sites or parts of them in urban areas for daily and short-term recreation not covered by the previous two categories.

Category IV - with partial maintenance of sites depending on the type of park elements and the degree of maintenance.

In the town of Haskovo the areas for wide public use are 1,464.630 acres, including 436.850 acres the most - visited part of the park "Kenana." Category I with representative maintaining includes green spaces in the ideal center of town. Category II with optimal maintenance includes areas in close proximity to downtown and the new urbanized sites. The third category includes all sites in the periphery of the city and neighborhoods "Orpheus" and "Badema". The fourth category includes natural terrains and large tree plantations in the Park "Yamaha" and park "Kenana", which

are partially supported.

The maintenance of municipal green spaces is an activity with building and repair characteristics, which ensures the completion of volumes and spaces, the agro-biological condition and technical condition of their elements and their aesthetic outlook, in order to increase their operational limits and ensure their efficient use.

Types of maintenance of the green spaces are determined by the location and purpose of various sites:

➤ Inner urban green areas:

- Servicing the entire city;
- Servicing different areas of the city;
- A small area, servicing a limited population.

➤ Specialized green spaces, thematically or functionally subordinated to other landscape elements (historical parks, green areas around monuments, etc.).

The structural elements that are used for the construction of the green areas are generally divided into vegetative and non-vegetative (usually 20-25% of the total area).

➤ The vegetative structural elements are:

- Lawns;
- Ornamental trees;
- Ornamental shrubs and roses;
- Flowers.

➤ The non-vegetative structural elements are:

- Communication facilities (path-ways, playgrounds);
- Park furniture (benches, pergolas, etc..)
- Aquatic areas and equipment (fountains, water mirrors);
- Engineering structures (retaining walls, cascades) and others.

The maintenance of the green spaces can be considered in three main aspects:

1) Current maintenance - constant activity associated with the cultivation of vegetative elements (hoeing, watering, mowing, pruning, etc.), Maintaining cleanliness (sweeping, washing, cleaning equipment, snow removal), security and others.

2) Current repair – aims at timely recovery of individual damaged and worn-out parts of vegetative and non-vegetative elements, removing deformations, small damage and other damage that do not affect the basic structure. This provides protection of green areas from premature wear, improves their appearance and ensures a high aesthetic effect to fully perform their function.

3) Full or partial recovery of key parts or structures of the elements of green spaces (paving alleys, landscape formation, etc).. Simultaneously with the full recovery there can be accomplished partial reconstruction. It is a reconstruction of the green areas to improve their architectural and planning organization and aesthetic image in accordance with current operational requirements, internal development and construction of the park compositions.

## **II. Preparatory work for landscaping**

### **Drainage of lawns**

At high levels of underground water the physical properties of the soil deteriorate and unfavorable conditions are created for the development of plantations. Tree and shrub plantings can grow and develop normally at underground water level not higher than 1.5 m from the surface of the ground. Lawns and herbaceous plants develop normally at the level of the underground water from the surface 50 cm. The main alleys and grounds must be dry. To prepare the plots for the civil engineering and agricultural activities, they should be drained, ie to take the high underground water and to decrease their level. One way is to build a pipe drainage system. The drainage system is a set of equipment with which captures underground water and removes or decreases their level. There are two types of drainage systems - open and closed.

### **Strengthening of slopes and banks of ponds**

To protect steep slopes from erosion and to strengthen the banks of reservoirs located within the green spaces, several activities are conducted to prepare the pitch. The main ones are grassing, turfing and planting of trees and shrubs. These measures are effective in slopes no more than 30%. Along the top of the hill at a distance not less than 1.0 m a drainage ditch is constructed, to receive and carry away runoff. It is effective to terrace steep slopes which are prone to destruction by building berms or intermediate sites.

In many cases the steep slopes can be made slanting gently and by applying admissible slanting of the slope is 1:1.5. Steep slopes with a slanting of 1:1 and more are terraced. For this purpose, initially we have to plow the soil across at 60-70 cm depth, the terraces are aligned with a bulldozer or motor grader, so that we can get a minimum width of 2.50 to 3.00 m Along the terraces makes Valcea ground, after which we introduce fertilizers, dig the holes and plant trees and shrubs. The edges are covered with grass or turfing. The distance between the terraces depends on the size and slope.

For strengthening the banks of ponds we use facilities whose construction is chosen in accordance with their intended use. Coastal embankments are made with slopes no greater than 1:2 to 1:2,5 for sandy-clay soils, from 1:2,5 to 1:3 for clayey and stony soils 1:0,5. To avoid the erosion and leveling of the banks and their washings we may use different ways to strengthen their underwater parts.

Grassing is done by seed or sod planting. Afforestation is accomplished by planting small seedlings or cuttings in parallel lines or grooves or on packages on the terraces at a distance between 0,5 to 1,0 m

### **Preparation of the soil**

To fully satisfy the requirements of plant species, the soil should be porous enough to allow water and air to penetrate freely into it, with loose grain structure with a grain size of 0.5 to 1.0 cm, nutrient-rich with minimal waste products.

After inspection of the soils, a number of measures are taken to improve them. In the construction of green areas in urban environments it is often necessary to import substantial quantities of fertile soil.

Sandy, light clayey and sandy soils and less fertile soils get dry in summer and are low in humus and minerals. The soil qualities to sustain and retain moisture improve significantly, by initially adding clay manure, compost or peat, and then introduce fertilizers.

Impermeable clay and heavy sandy and clay soils become thicker and swampy during rainfalls and in the winter and crack when in dry summer. The soil qualities are improved by adding sand mixed with straw or horse manure and peat humus soil.

Infertile, poorly drained, swampy and acidic soils are also low in minerals. To improve their quality, we build drains, then plow and introduce lime or finely ground limestone, organic and mineral fertilizers.

Calcareous soils are excessively drained and alkaline. They are fertilized with peat or compost and physiologically acidic fertilizer (ammonium sulphate, etc.).

The qualities of anthropogenic soils depend on the amount of impurities, the size of skeletal fraction, water properties, availability of nitrogen and phosphorus and humus content. Suitable for use are only bulk soil A and B horizons. For them, mineral fertilization is recommended with nitrogen and phosphorus fertilizers.

The turf areas with overgrown grass cover require precise tillage to remove weed - seeds and roots - and several harrowing and leaving fallow land.

### **Soil fertilization**

The fertilization of soils is one of the most important means to improve their maintenance regime. It can be made with organic, organic-mineral mineral and bacterial fertilizers.

Organic fertilizing is made with manure, peat and compost, as well as a green manure.

The effect of manure occurs in the course of several years after its introduction. It is estimated that 28% of the manure becomes humus and 72% of it is mineralized in available nutrients for plants. Its composition depends on the degree of decomposition. It is recommended for storage not to reach burnout manure. In the rational use of manure (about 2-3 t / dka) water contents quality of the soil is increased by about 20%.

The mineral fertilizers are divided into nitrogen, phosphorus, potassium and complex. All the nutrients contained in fertilizers perform in plant their specific functions, and therefore cannot be replaced with another one. Inadequate and untimely securing of plants of only one of the necessary elements weakens their growth and sharply reduces their quality. The excess of nutrients is harmful. Mineral fertilizers can be used in the form of mixed fertilizers.

Depending on the time of submission, fertilization is general, pre-seeding and nourishing.

The methods of fertilization are also different depending on the type of fertilized plants and timing of fertilization. They can be scattered, and aligned in lines and in clusters.

### **Standards of watering**

Watering of lawns is required if current soil moisture drops below 50-60% of the marginal field moisture. This is determined by taking soil samples in the middle of the depth of the root layer as follows: for grass areas and flower beds of depth 8-12 cm, 15-20 cm for shrubs and for trees 30-50 cm Watering is done according to estimated soil moisture to reach 70-80% .

Water is one of the most important environmental factors. Therefore, artificial gardens need regular irrigation to ensure that they are alive and evergreen.

Depending on the conditions vegetation can be watered by hand or by stationary tankers irrigation system. When watering with a sprinkler systems, the evaporated water from the soil and the water separated by leaves water, as well as water lost in the drain, is compensated which is

their advantage.

### ***III. Activities for maintaining vegetative structural elements of green areas***

#### **1. Lawns**

Park lawns can be created by using one form of grass or grass mixtures of several types.

Mono-cultures are created only in special cases, mainly for temporary and short-acting representative homogeneous lawns. They are not resistant to disease and require intensive maintenance.

Mixed cultures of grass mixtures are preferred because they are the basis for the formation of more vital grasslands. Their advantages are: mutual complementing of the various components in the rates of growth and longevity of life cycle; fuller utilization of nutrient elements in the soil, greater flexibility and environmental sustainability of the community as a whole, forming denser turf grass, thanks to the combination of different types of morphological features. Under optimal growth conditions we typically use two or three components. With unfavorable soil and climatic conditions with limited maintenance, the component of the mixtures should be increased to four or five types.

To fulfill their purpose, lawns should possess the appropriate qualities – flat surface, solid coverage without weeds and fresh green color. Full effect can only be achieved in carrying out the necessary activities that are dependent on the type of site and intensity of maintenance.

#### **1.1. Biological and functional requirements for the combination of the park grass mixtures**

The functions of grasslands are manifold. They are determined by the type of plant cover and the function of green space as a whole.

##### ***1.1.1. Type of plant cover***

The type of plant cover of park grass spaces and grass covering substitutes that can be cut low and even, allowing to build vegetation cover with flat horizontal impact. The public importance of grasslands is measured by yet one more indicator - how they can be used for purposes of recreation. It is this type of vegetation cover, which can be walked on, which allows grass spaces to be developed as an accessible park spaces.

##### ***1.1.2. Degree of maintenance***

The degree of maintenance (intensive or extensive) is determined by the specific conditions of load and habitat.

The most intense (deluxe) maintenance should be applied for the representative park lawns for golf. Lawns in gardens and parks must be maintained with an ordinary intensity, as well as all of the decorative grass areas for sports (except for use of lawns for week and annual vacations), all sports and special areas in order to strengthen the grass cover.

Extensive maintenance is applied usually for lawns (decorative and sports- type) and special grass areas in the open landscape, with the exception of division, sidewalks and banqueting strips along roads which have to be maintained more intensely.

##### ***1.1.3. Use grass seed mixtures***

The need to use grass seed mixtures of several types to create grassspaces is undoubtedly a requirement which has been confirmed by modern park engineering practice. Beautiful and sustainable grass cover can be created from a single species (monoculture), thus achieving better

uniformity and homogeneity of the turf. The expected results in this way, however, can be obtained in full compliance between environmental requirements and conditions of variety of habitat and intensive maintenance, which is practically difficult to accomplish.

The combination of several species in common seeding mixture has many advantages and the formulation and use of appropriate grass seed mixtures is one of the main prerequisites for obtaining high quality grass cover. The expected result is achieved if we provide the necessary conditions of the habitat and apply the appropriate farming practices in their creation and maintenance.

The seed mixtures in our conditions should be constructed on the basis of two subspecies of red fescue, meadow grass and common grass to provide real opportunities for greater use of their cultivates. Such mixtures can be prepared and based on comb-type grass.

## **1.2. Major manipulations in re-grassing**

### ***1.2.1. Basic tillage of the soil.***

Optimal conditions for the establishment of lawns are found on areas with a slope of 25 degrees, and sun exposure. Suitable soils are mild to moderately fertile sandy loam soils with slightly acid reaction of the soil solution with a porosity of approximately 50%, availability of humus layer of 15-20 cm and the underground water level is not more than 70 cm

The soil tillage improves the mechanical composition of the root soil layer. It is performed after modeling the terrain and improving the properties of the soil. The soil is treated an average of 30 cm depth. After the treatment is beneficial for soil to mature 15 to 30 days before the pre-processing.

When plowing dry soils, it is advisable to irrigate. After deep plowing clods are crushed and the surface is leveled .

It is obligatory to have made arrangements for improving soil through fertilization. Organic fertilizers are poured with a loose layer of 2-5 cm on the treated soil, then they are hoed at a depth of 15-20 cm. The compost is introduced at 2-3 tons / ha mixed with super-phosphate - about 50 kg / ha. Average fertilizer stockpiling is obtained upon import of ammonium sulphate - 30-50 kg / ha super-phosphate = 30 kg / ha, potassium salt - 15-20 kg / ha.

### ***1.2.2. Pre-treatment of the soil to a depth of 5-10 cm.***

Pre-processing is precise mechanical processing and alignment of the surface (5-10 cm) soil layer and the soil surface milling. Lumps should be broken up to soil grain size of 1-3 cm and a representative area about 0.5 cm

After pre-processing again it is advised to allow a rest 10 to 12 days for the soil to settle and weeds to sprout so that they can easily be destroyed by loosening and re-alignment.

### ***1.2.3. Sowing grass seeds***

If we want the sowing to be of high quality we should sow and bury the seeds evenly. The seeds are sown by hand, small seeds are mixed with fine compost earth or sand. It is obligatory that the sowing is done in calm windless weather. Heavy seeds should be sown separately and not be mixed with the lighter ones. At the edges of the grass areas grooves are made with denser planting. After sowing the seeds buried with paddle and re-consolidated with the help of a board or rollers.

The accepted norm is 25 to 30 kg / ha. The density of the crop depends on your grass mixture and the purpose of lawn.

During germination we should water frequently. Wilting under drought can be prevented by mulching. It is necessary especially in slopes facing south. The mulch could be straw, hay, sawdust,

perlite and shredded peat.

The depth of planting is an important prerequisite for obtaining high quality seed. Determination of the depth of a crop depends on soil type, size of seeds and their ability to germinate, on the reserve of soil moisture and requirements of grass species to light during seed germination. Small seeds are planted in shallow ditches of 0.5 to 0.6 cm, and the larger 1.5 to 3.0 cm.

The time for sowing has a major influence on the time of germination and growing of the young grass. It is also linked to time for the formation of a sustainable turf grass and for forming the composition of the grass. Seeds germinate best at a constant soil temperature of 12 C to 15 C.

The first mowing is done manually at a height of 5.6 cm It is admissible to use a mower with a sharp blades. The goal is not to tear or lose young grasses.

#### ***1.2.4. Turfing***

It is used to strengthen the embankments and slopes in bordering alleys, in repair of central park areas and especially in creating sports and children playgrounds. We can use natural and artificial turf.

The arrangement of the turf is performed on pre-treated soil with leveled surface so that the transverse joints do not coincide. Turf should adhere tightly to each other and then after their arrangement we get a flat surface. The joints are filled with earth or sand. Irrigate thoroughly with water.

### **1.3. Basic manipulations while maintaining lawns**

Maintaining a lawn is one of the most important prerequisites for obtaining high-quality turf grass. Inadequate and insufficient care might compromise even the most precisely-created lawns. On the other hand, good maintenance of scarce and weedy turf, can transform it in dense and fresh grass cover.

#### ***1.3.1. Mowing***

By mowing we adjust the height of the grass. This provides greater access of light and air to the growing node. Intensively maintained grass areas should not be allowed to grow higher than 7-10 cm. The height of the cut depends mainly on the purpose of turf, on the soil, air humidity and morphological characteristics of grass.

Intensively maintained lawns are mowed to a height of 3.4 cm. The main rule is to mow more often and not less than 3 cm. Each mowing should take no more than 50% of the available foliage. During periods of drought we should be mow less often by cutting a greater height - 5 to 7 cm.

Depending on weather conditions, purpose, intensity of fertilization and irrigation, we determine the frequency of mowing.

#### ***1.3.2. Sustaining***

The need to aliment grass increases with the frequency of mowing and the depletion of fertilizers and water supplies. In case of shortage of nitrogen, phosphorus, potassium and magnesium, the intensively maintained lawns begin to grow thin and weedy. Their drought tolerance is reduced, as well as their durability and resistance to trampling. In the first year perennial grasses need especially nitrogen and phosphorus. In the spring when the soil is still poorly heated and activity of soil microorganisms is weakened, plants experience a shortage of available nitrogen. After mowing the need for all nutrients dramatically increases, the most important of which is nitrogen. Potassium is needed in significant quantities in growing. At the end of the growing season phosphorus and potassium are most important, as they increase cold-and drought tolerance of grasses.

After each aliment grass should be watered. Between cutting and aliment should be an interval of two to three days, and the height of the grass should be about 5 cm

### ***1.3.3. Machining of grass turf***

With this manipulation we maintain normal water - air exchange and normal vital activity of microorganisms. This is one of the most important events for the renewal and reconstruction of grass turf. This is achieved through dragging, surface penetration, aeration and Verticutter manipulation.

Dragging takes place in the spring and is performed by rakes. In this way the old dead grass is removed, together with dried leaves and twigs and debris. We recommended dragging of grasslands if aeration machines are not available.

### ***1.3.4. Applying sand and humus***

This operation aims to improve water and air and nutrition rates of the soils. Sanding is performed by sprinkling on the grass cover on the humus soil, peat, gravel and compost - either alone or mixed. This operation takes place between April 15<sup>th</sup> and August 15<sup>th</sup> once in 3 or 4 years

### ***1.3.5. Irrigation***

Rainfall in the area is insufficient, and grass areas should be watered regularly, to maintain optimum soil moisture in the root layer, which is 70-75% of the solid field moisture. Annually lawns need no less than 2 800-1000 l/m. Irrigation norm for the intensively maintained areas 10-15 l/m<sup>2</sup>.

The need for irrigation can be determined visually by subtracting piece of turf 10 cm thick and check if the one-third of the peak is dry, it means you need to be watered. When watering lawns it should be noted that the majority of the grasslands are laid shallow – at a depth of 10-15 cm of the main root system. Therefore, in drought, they are difficult to be supplied with water from deeper layers of soil. As a result of this shortage of water grass starts to get yellow and dry.

Watering should be done immediately after mowing. It is performed throughout the growing season from April to September, depending on the distribution of precipitation.

### ***1.3.6. Cleaning dry leaves***

It is performed before leaves growing in spring and in autumn during leaf fall. The leaves are cleaned in dry weather, and solid waste - before each mowing. Most suitable are the automatic sweepers, mobile suction appliances and rakes.

### ***1.3.7. Cleaning weeds***

Weeds grow where the crop is scarce on loose soil. The homogeneity of the grass turf is destroyed by both dicotyledonous weeds with broad leaves and grasses of large blades, protruding from their bulky turfs. This requires systematic control of weeds - annually from early spring to late autumn, and not allowing them to bloom and ripen their seeds. With regular mowing we prevent the development of annual weeds. The majority are perennial, recurrent and spread themselves in grass composition.

To prevent overgrowing with weeds we use sterile humus soil, remove weeds sprouted before sowing the grass, and use clean and quality seeds. Weeds are removed before their flowering; mow regularly, nurture regularly and deliberately, use herbicides.

### ***1.3.8. Pest and disease control***

These are phyto-diseases and insects. The grass is most often damaged by the larvae of the May and the June beetles, snails, moles, worms, mice and more. The most dangerous fungal diseases are Fusarium, brown and pink mottling on leaves, snow mold and others. As a precaution, we use aeration, fertilization and Verticutter application.

By lowering the values of soil reaction (pH) 4.5 to 5.5 we achieve better effect in reducing pests.

### ***1.3.9. Suppressing weed growth by chemical means***

This is applied in extensively maintained lawns. Acidifying substances and solutions have detaining effect.

### ***1.3.10. Requirements to facilitate the maintenance of lawns.***

The most important of these are:

- Placing the edges of the lying tiles to maintain the outlines of grass. Planar connecting of lawns with tiles, caps and shafts and clearing single planted flowers, roses, shrubs;
- Tubers, bulbs and flowers basins should not be planted in intensively maintained lawns. To allow mechanized mowing we must prune partially deployed flowers and shrubs and also to surround stem lying around edges;
- The shaded areas and under the trees should be planted with shade-resisistant herbaceous plants as grass replacements.
- Undersized and uncomfortable for machine mowing lawns should be planted with shrubs and low species which do not require maintaining;
- - Modeling of terrain and shaping of grass and plant groups in it, take place in view of the opportunities for profitable mechanized irrigation and maintenance.

## **2. Ornamental shrubs and trees**

### **2.1. General requirements**

The task of maintaining ornamental plants is to provide the necessary conditions for the deduction, the further development and revealing of their decorative qualities.

The required technical support operations of trees and bushes are: tillage of soil for planting and ongoing treatment. Tillage for planting aims at improving water and air regime and structure of the soil, and to stimulate the microorganisms. The task of the current tillage is cleaning from weeds, alleviate moisture retaining and aerate the soil around the roots.

### ***Seedlings***

We use saplings of ornamental conifers and deciduous trees and shrubs for planting in lawns

The requirements for the size, age and other characteristics of ornamental seedlings produced in nursery gardens are regulated by BSS.

- BSS 3124 - 82 saplings of ornamental shrubs;
- BSS 3125 - 82 saplings of ornamental conifers
- BSS 3126 - 82 saplings of ornamental deciduous trees

**Grouping of trees and shrub species** is based on the following principles:

- - Environmental, which allows to build sustainable growth conditions of the respective groups;
- - Phylogenetic, which allows to build vibrant groups of mutually tolerable (noncompetitive) plants;
- - Systematic, which provides differentiated shaping of space and scale constructing of groups without compromising the unity of the composition;
- morphological, which allows to build a harmonious reconciliation with the species in structure, color and texture.

### **2.2. Planting trees and shrubs**

#### ***2.2.1. Calendar terms for planting***

Deciduous tree and shrub seedlings from nursery gardens are transplanted in landscape sites during the course of their leafless state, ie in autumn from the beginning of leaf fall from until the frosts and in spring from the time of draining and drying of the soil to the swelling of buds. Transplanting of seedlings with sufficient and well-fixed root ball under certain additional requirements cultivation is possible throughout the year. Plants, carried in containers, can also be planted in all seasons.

*Autumn planting* - it is made from early October to early December and is preferred for most types and is practiced for seedlings with an open root system because till the onset of winter, they form more roots. For evergreen coniferous and deciduous species with root ball it is recommended to plant between mid-August and mid-October.

*Spring planting* - it is made from March to early May for seedlings with an open root system. Preferably species with hardwood - poplar and willow. Birch also can be transplanted only in the spring during the bursting of buds. In spring we plant all thermophilic species, sensitive to low temperatures. Plants which will be grown in containers are also planted in the spring - until May Spring planting is used in long cold winters and on heavy land, not ventilated, cool and wet soils. For trees with root ball, spring planting is done by the end of February to mid-April.

### ***2.2.2. Preparation of the soil***

The introduction of fertilizers and additives in planting small saplings in small-and large arrays and in protective vegetation in urban green areas is usually done after the delivery of plant-soil on the site and its distribution in even layer. Fertilizers and additives are imported directly into propagating pits, ditches and trenches which are carefully mixed with the soil. Mineral fertilizers are imported at the bottom of pits and trenches before planting and are well mixed with loose soil.

The soil is treated according to the method of planting. When planting small-tree and shrub seedlings especially in large and dense arrays and lines it is appropriate to make full preparation on soil throughout the area – they should be well plowed through the full depth in the autumn and harrowed and cultivated in spring.

All types of standard trees in lawns are planted in pits of different sizes, depending on the specific size and type of saplings.

### ***2.2.3. Tree seedlings with an open root system***

#### ***Preparation of the seedlings for planting***

The preparation of seedlings for planting comprises three stages: extraction, transport and storage. The main objective of the preparation is the preservation of the viability of the seedlings through precise execution of all operations.

Seedlings are transported with the roots forward in a horizontal or vertical position. In cases of prolonged transport in open trucks they are covered with tarpaulins.

Seedling material can be stored temporarily on site for a long time. Seedlings are temporarily stored in pre -dug pit. They are immediately placed in it, covered with loose soil and watered thoroughly with water. Longer storage is used when it is necessary to extend the standstill period in the spring and early part of the summer due to high volume of work or for planting in spring , next to the supplied in the autumn trees. In such cases, special we dig special trenches.

### ***Planting techniques***

Before proceeding to the planting of the site, according to the planting plan we draw a grid of cells with dimensions 2.00-3.00/2.00-3.00 m. The planting itself should not be done in wet, sticky and tilled soil.

We start with digging pits, usually with circular section with the mentioned above dimensions. Their walls are vertical or inclined. Pits on the sidewalks near the alleys, in the yards of kindergartens, schools and inter-neighborhood spaces are dug at least 5 or 7 days before planting to allow the walls to "ventilate" and get rich in oxygen. In areas with heavy soils or heavily contaminated with debris digging is done 2 or 3 weeks before planting. In mass plantings over large areas pits are dug even 2 or 3 months before planting. Their bottom is loosened to a depth of 10 to 20 cm

Mounting poles should be placed in the soil to a depth of at least 1.00 m, driven in advance to the solid bottom of 20 to 30 cm in height. They should reach a height of at least 10 cm below the top of the crown. They are also placed 10 cm away from the center of the pit.

When planting deciduous tree seedlings with root system with open branches it is necessarily to shorten them to do a third of their length. In saplings with central growth, such as birch, Lombardy poplar, horse chestnut, ash and others the crown is reduced less. The side branches should be shortened so that they reach just below the summit leading shoot.

#### ***2.2.4. Tree saplings with root ball***

We transplant all evergreen coniferous and deciduous species with root ball, big and oversized deciduous saplings and mid-sized seedlings from some deciduous species that tolerate transplanting with difficulty - birch, oak, walnut and others. Their preparation consists of three stages: preparation, extraction and transportation.

The seedlings are removed manually and mechanically. The basic requirement is to create a root ball with optimum size and firmly fixed soil. Full mechanization of processes for removal and transportation of seedlings with root ball is accomplished with the help of special self-propelled machines that have jawed-hoes devices with several metal segments.

The seedlings with the root ball are planted in pits with square or round section. Before placing the seedlings the bottom of the pit is loosened to a depth of 15-20 cm, then we pour over it 20 or 25 cm compost to get a "soft soil cushion". The regeneration of the root system is accelerated through the use of fertile humus soil with additions of well-decayed lowland peat and granular super-phosphate at the rate of 1.5 kg/m<sup>3</sup>.

#### ***2.2.5. Planting ornamental shrubs***

Shrubs are planted in holes with dimensions of 40/40/40 cm. When planting shrubs in a common trench initially we make individual holes with a size according to the size of the roots. Ground part of the deciduous shrubs is pruned at a height of 10-15 cm above the root stem or is limited to 3 to 5 leading shoot, which are shortened by 1/3 to 1/2 the length. In evergreen deciduous shrubs are removed and only the lower or damaged branches during transportation. Watering of newly planted bushes is abundant - 10 to 20 l per plant. The contour of the entire group is lined by earth shaft. In droughts, we must watered every week. Evergreen shrub seedlings are watered repeatedly until autumn frosts occur.

#### ***2.2.6. Planting trees for hedges and green walls***

Saplings, which will form the hedges and the green walls are planted in a ditch, pre-dug and re-filled with humus soil to 3/4 of its volume. For spring planting it is desirable to dig ditches in the autumn, and for autumn planting - one month earlier.

Hedges are constructed by seed shrub and tree species. Hedges can be in one, two and three-lines, while the latter are alternately planted in ditches.

Border edges are constructed with low, slow-growing shrubs and low-growing forms of coniferous species.

Green walls are constructed with pricked and tempered tree and shrub seedlings. They can be planted at the specified distances and may be in one, two or many lines.

The basic requirement is to plant seedlings in rows precisely aligned. After planting, longitudinally along the edge of the gutter a concave strip is formed by constructing ground Valcea. The recommended limit for irrigation is 10-15 l / pc. When constructing hedges, after the planting of saplings of deciduous species, they are only cut on the top with 1/3 to 1/2 and is aligned in height. Coniferous trees are reduced in height only marginally. In the construction of green walls we trim only the damaged and sprouted shoots.

### ***2.2.7. Specifications for transplanting in winter and summer***

In winter seedlings are transplanted with a soft pack with frozen root ball. The basic requirement is to shorten the time between digging and planting it the maximum. Depending on the complexity and labor consumption of the performed work there are three terms for winter transplanting. The first period is from November to December. The second is from January to February, and the third is in March.

In transplanting plants during the growing season from May to September, we should consider their status and the different stages of their development. There have been three periods of transplanting where saplings have varying degrees of offset. The first period is from May to mid-June, the second period is from mid-June to July and the third period in August.

The special technology for the summer transplanting involves mainly the use anti-transparents. They are made from 5-8% aqueous dispersion of synthetic latex, soap (in a dosage of 3 g / l) and water. The plants which are due to be transplanted are sprayed in advance in the nursery garden with an aqueous solution of defoliant (0.3-0.5% magnesium chlorate pure substance). During the leaf-falling, which starts 8 to 10 days after spraying, the seedlings are dug out and transferred to the site or placed in permanent storage pits for the winter in order to be used for spring planting.

### ***2.3. Post-planting cares***

The post-planting cares include intensive agricultural activities mainly to restore the root system. With newly planted small shrubs that recovery lasts between 2 to 3 years, 6 to 11 year old tree seedlings the period is 3 to 4 years, and at large trees and shrubs need more than 5 to 6 years.

#### ***2.3.1. Current and annual treatment of soil around trees and shrubs***

The two types of tillage include hoeing and loosening.

Hoeing is done three times - in spring, summer and autumn. Depending on the specific requirements of vegetation, hoeing is done at a depth of 8 to 15 cm and at a radius of 30 to 50 cm and for the shrubs and 40 to 70 cm for the trees. When plant species are put under less favorable conditions (roads, in heavy soils) they are hoed more times. During processing we should take care not to damage the surface lying roots. Newly planted species are hoed more shallow.

Loosening of the soil around the single - planted shrubs and hedges is carried throughout their lifetime, and around the trees - in the first 8 to 10 years after planting. This is done at least 3 to 5 times during the growing season (early spring, summer and autumn) at a depth of 4.5 cm

#### ***2.3.2. Spraying and mulching***

The crown is sprayed especially during the summer droughts. In the second year after planting, we apply spraying combined with external root feeding. The feeding can be conducted in two phases – in the phase of intensive growth and development of shoots and roots and in the phase of complete leaf-fall. It is advisable to mulch at a thickness of 3 to 5 cm in the area around the big

and oversized saplings and those transplanted in the summer.

During the post-planting period we also check the strength of the poles, guy lines and bandages with which seedlings are attached. They can be removed after 3 or 4 years.

### ***2.3.3. Fertilizing the soil and plant feeding***

Trees and shrubs grow for many years in the same spot and continuously drain the soil. Deficiency of nutrients is critical for their condition, especially in the adverse conditions on the streets, boulevards, and industrial areas, which is evident by their appearance. In such cases the leaves become smaller and necroses appear, the shoot growth decreases sharply, unusual coloring appears, we witness premature fall of the leaves, secondary leaf-growing and secondary blossoming, lichens grow on the bark.

In a well-prepared soil the application of fertilizers can start from the third year after planting. The specific rules and deadlines for submission of these and other fertilizers are determined based on the condition of the plants and on the basis of the analyzes which should be performed every 3 to 4 years.

The introduction of organic fertilizers in the busy city green areas is hampered by the sanitary and aesthetic reasons. However, their complete neglect is inappropriate. In urban burdensome conditions they are extremely important for the development of trees not only as a "complete fertilizer", but also as a means of improving the structure of soil and its microbiological activity.

The mineral fertilizers are introduced only when the vitality of trees and shrubs has been damaged by the adverse impact of the urban environment. Generally we use ammonium nitrate, and potassium chloride and super-phosphate. Applying nitrogen fertilizers can begin in the second year after planting, and phosphorus - in the third and fourth year.

Fertilizers which are used to feed plants are introduced mainly as an aqueous fertilizer solution. The advantage is that the nutrients present in the aqueous solution, quickly penetrate to the roots of plants and provide both nutrients and water.

### ***2.3.3. Irrigation***

Due to insufficient rainfall in the country during the growing season we have to compensate the shortage of moisture in the soil by watering. Along with irrigation water we can also introduce dissolved fertilizers and nutrients which are needed for the development of ornamental plants.

In the first 2 or 3 years the newly -planted trees should be watered more often. In hot and dry weather, especially in the first year, the 10 to 15 year old seedlings are watered once in 5-6 days and larger ones - each week. For a season the irrigation should not be less than 10.

The irrigation rate and repeatability of irrigation, however are defined differently depending on the age of the seedlings, on their varietal characteristics, the location of the site, the relief features of the terrain and the type of soil.

The average irrigation norm is determined according to the age of the sapling: for shrub species: 10 to 20 l / pc., for mid-sized tree seedlings: 40 to 50 l / pc and for big-sized tree saplings: 100 to 150 l / pc for over-sized trees: 200 to 250 l / pc.

Another method is drip irrigation. It may be done through underground or above ground placement of dripping hose. Water saving in this technology is essential which determines its increasingly wide application in irrigation of park areas.

## **2.4. Pruning of trees and shrubs**

### ***2.4.1. General terms***

The purpose of pruning is to regulate the shape, size and flowering of trees and shrub

species. Thus they perform their functions better and slow their aging. By pruning new stems, twigs, flowers and leaves are produced. It removes aging, declining and oppressive stems and branches, it helps dense crowns to be lined, more light is provided and the living space of the plants is increased.

Types of pruning aim to: form the crown shape, to enhance flowering, to rejuvenate and sanitary pruning.

The whole rest period from autumn to spring is equally suitable for carrying out pruning. In the cold winter it is more appropriate to accomplish pruning in early spring to avoid possible damage from low winter temperatures. The wounds and the places around them are more sensitive to cold weather and often the cambium declines, thus preventing the normal wound healing. In the spring we should not be late with the pruning because by trimming the already awakened parts the development of other parts is slowed down and the losses of plastic materials are larger. In warm winter pruning can be carried throughout the whole rest period, beginning immediately after the autumn leaf fall.

Most of trees and shrubs are pruned when the circulation of the saps have not started - in late autumn and winter. Then the plant is at rest and a significant amount of stocked nutrients move in the thick branches, stems and roots. During this time the crown is defoliated and easily observed. At temperatures below minus 4 degrees C pruning is suspended. Plants can be pruned in summer or in early autumn, ie during the growing season, since then the wounds heal more easily

The technique of pruning is essential to the form and vigor of plants. The cut surface should be as little as possible (horizontal or slightly inclined) to allow the wounds to heal faster. The side straight branches are shortened at external bud, and the branches with a greater angle - at the internal or lateral bud. Crooked twigs are cut at a side bud. Pruning the older shoots in the bushes is usually made at the base so as not to form a stepped and obtuse branches.

The methods of pruning consists of shortening (clipping) and thinning (cutting). With the first method we remove part of the shoot, all the top buds and part of the side buds. With the second method we cut (remove) completely intact parts of the plant - shoots, branches, twigs.

#### **2.4.2. Pruning of trees**

Pruning of trees should be done preferably not so often. For some species, the pruning for shaping plays a greater role. It is the foundation for providing a representative construction of the crown in the first year after planting.

Tolerance to pruning to form a crown depends on the regenerative ability of the species. With good tolerance are lime, poplar, elm, soforata, hawthorn, and apple trees. Average tolerance is characteristic of beech, willow, sycamore ash, plane, ash, maple, white acacia, fir, western Thuja, Juniper and others. The horse chestnut, birch, larch, walnut, cherry, oak, pine and spruce show little tolerance to pruning. Age also has its impact on the trees. Birch and larch respond well to pruning at a young age. American red oak at a young age can also withstand partial pruning. Ash and beech can pruned only up to 40 years old.

*Pruning for storage* is limited to any necessary adjustment of growth conditions, to maintain the typical for the type shape of the crown and to remove decaying timber. The thinning of the crown should be performed promptly after it starts to peel from the inside.

*Pruning for rejuvenation* is mainly suitable for trees which regenerate better at a higher age and then they can grow in whatever habitat ( for limes, sycamores, poplars, willows). We start the recovery of already stopped vegetative growth by rejuvenating of the semi-skeletal branches. Then we reduce the skeletal branches.

The complete crown cutting (pruning of the head) is not recommended. It leads to the emergence of numerous succulent shoots with long growth period, which slows their normal maturation and leads to their frosting. Large wounds can also be found, as a result of which the

timber starts rotting.

*Pruning for stimulating* the blossoming of trees consists of thinning and rearranging the semi-skeletal branches, on which are located the shortened branches with the blossom buds.

*Pruning for the formation* of the crown begins at a younger age. In designing activities for pruning we should consider the reaction of the certain types to this operation and the need of the type to regulate the growth by pruning. In shaping the crowns for species with beautiful blossoms we should aim to achieve good lighting of all its parts. Along with the setting of the basic skeletal branches we should be careful to enrich the crown with semi-skeletal branches.

Once the crown is formed, pruning is dependent on the type of plants and their category. The pruning is usually not performed in gardens, parks and squares in groups and single planting. With linear plantings along streets and highways, pruning is performed if necessary to ensure the traffic safety, when by pruning we lift the level of the crown.

*Sanitary pruning* is not related to the age of the trees. It is done if necessary when in the crown dead or diseased parts appear.

### **2.4.3. Pruning of shrubs**

A characteristic feature of the shrub vegetation is the ability to rejuvenate their stems naturally, to restore as a result of the formation of stem shoots. In some species the formation of shoots from the area of the root neck is more strongly expressed, from the underground stems (rhizomes) and roots. With bushes the age of the separate stem is always less compared to the total age of the shrub. Therefore, there is a natural dying of the shrub stems and replacing them with new ones. If declining stems not removed promptly, shrubs lost their decorative appearance. Pruning in this case appears to be a necessary activity in the cultivation and maintenance of shrubs.

By pruning we aim: to enhance the growth and formation of habitues, to preserve the construction and stimulation of abundant flowering and fruiting, to facilitate the formation of replacement shoots of rejuvenation. In relation to this we can proceed with pruning (shaping), pruning for storage and rejuvenation pruning.

Types of pruning for shrubs are: growing (formation), storage and rejuvenation.

### **2.4.4. Pruning of hedges**

Pruning hedges, depending on their purpose, has a different intensity. The green walls of shrubs and trees growing unobstructed, do not need pruning every year, but only need to be cleaned of dry branches overblown blossoms. For them the pruning is conducted according to the biological characteristics of species in free-growing shrubs. They are grown with pruning to keep in canopy that enhances and directs the further preservation of species typical crown

The number of pruning for one growing season, and the shape of the hedge depend largely done on time first pruning. The optimal time for it is set, depending on the speed of growth, the time and place of the growth of new shoots and characteristics in the development of dormant buds.

Old and bare hedges grow younger by cutting the stump. The best time for this is early spring. The formed cutting are coated with horticulture ointment and the soil should be loosened and fertilized. Such pruning is not made for coniferous and deciduous weak ability to produce shootings.

## **2.5. Additional care for the crown**

*Perfusion of the crown* has to be done in prolonged droughts in major cities and industrial areas where the trees are covered with a thick layer of dust. When pouring water over the crown along with the dust the insect pests are removed. In one growing season deciduous are perfused 5 to 6 times, and conifers 8 to 10 times.

*Protection* from insect pests and external root feeding are based on the joint use of aqueous

solutions of insecticides for destroying pests and fertilizers for feeding. The mixture of these is sprayed over leaves, branches, shoots and stems

*Preparation* for the winter and spring revival include care to protect the crowns of native thermophilic plants from frost in winter. These are mainly evergreen shrubs - rhododendron, lagerstremiya, ileks, laurel, Japanese spindle, Foti, hydrangea and more., as well as some deciduous trees such as magnolia and other sensitive non-indigenous conifers and shrubs. The ground parts of these plants are usually wrapped with straw mats or burlap.

## **2.6. Maintenance of the stems**

### **2.6.1. Treatment of wounds**

When plants alone can not heal their wounds which result from mechanical damage, frosting, improper pruning, etc., they should be immediately treated. For this purpose, the wounds are cleaned, shaped into elongated shape with pointed end pointing the ground and sterilized to destroy all infected areas by fungi and other parasites that are found on the surface. Closing the edges after sterilization of the damaged area and the edges goes on with the appropriate use of sequential suitable covering substances, fungicides and promoters.

### **2.6.2. Treatment and sealing holes**

Treatment and sealing of holes is necessary to stop the process of decay and preserve the decorative qualities of trees. For the majority of tree species the most suitable time to treat hollows is warm weather - from May to October. Exceptions can be made for the birch, maple and poplar, for which we recommend that treatment in early spring during the active cambial activity. Hollows processing begins with the removal of infected layer of wood, then a layer 0.5-1.0 cm thick, where there may be hidden decay. After the formation of hollow we sterilize it and make watertight plaster, mostly asphalt. Depending on the processing we can specify open, closed and filled holes.

### **2.6.3. Additional cares for the stems**

The consolidation of branches and tree trunks is an important measure, which helps to avoid the breaking branches caused by snow accumulation and the injury caused by wind friction, improper pruning and other. It is particularly important for species with brittle wood like willow ash maple, birch, linden and others, as well when replanting the large-sized trees.

Horizontal reinforcement is made of solid props. Vertical reinforcement can be achieved with fixed supports or metal staples.

Cleaning of old trunks of trees from dead bark layers, mosses, lichens and wintering in the crevices of the bark insect pests, must be done annually in the spring.

The installation of protective fencing is recommended for all trees in the streets, boulevards, courtyards and other areas where there is a risk of mechanical damage.

Bent trees are straightened whenever stems are slanted or skewed. For trees that defy straightening, we put constant and strong support.

## **2.7. Diseases and pests of tree and shrub species**

The Manual addresses the main insect pests and diseases of woody shrubs.

## **2.8. Uprooting and cutting of trees**

Uprooting is the removal of trees and shrubs with stems and roots. It is justified when broken trees rot, or are already dead. Cutting is cutting the trunk of the tree when the roots and stem stump remain in the ground.

## **3. Roses**

Roses are plants that require sunny habitats, rich in organic matter, sandy loam soils with a neutral to slightly alkaline and to neutral and slightly acidic reaction (pH 6-7) and low groundwater. They are not suitable for northern parts and areas not ventilated sunny western and southern sites near buildings where roses are overheated, also unsuitable are places near roads and alleys where the air is extremely dusty, dry and overheated. The preferred habitats for roses are protected from strong winds, particularly from the north. The most suitable sites for the development of Rosaries are in park setting. For Haskovo area which is warm and at a low altitude east and west are the appropriate sides.

### **3.1. Classification**

Depending on usage patterns and biological characteristics roses are divided into several groups: roses for flowers to cut, roses for rose beds and merged groups, miniature roses; park (high bush) roses, and climbing roses (creeping, trailing) and tall roses.

### **3.2. Processing and fertilization of the soil**

It is desirable to process the soil in the autumn as well as during the autumn and spring planting. We plow to a depth of not less than 70 cm. The dimensions of propagating pits are 40 to 60 cm wide and 30 to 40 cm deep.

Basic fertilization is done with organic fertilizers, primarily with well decomposed manure at the rate of 6 to 8 kg/m<sup>2</sup>. It is brought at a depth of 30 to 35 cm together with it, between the two layers before plowing the soil we should be do complete (NPK) fertilization. Low values of soil reaction are adjusted by submission of lime in the form of limestone at the rate of 200 kg / ha.

Manure and limestone are introduced in the autumn during deep plowing and fertilizing the surface with mineral fertilizers is carried out in early spring.

### **3.3. Rose planting**

Roses are planted after the tilled soil is left for 1 or 2 weeks. For the region of Haskovo autumn planting (October-November) is preferable as in winter plants can produce roots and in spring they grow vigorously. For roses in containers we recommend planting in spring (March-April). In droughts, 1 or 2 days before planting pits are watered thoroughly.

Before planting the root system of roses is slightly trimmed. We cut only the longest and the damaged roots. The roots of climbing roses are cut at a third of their length. When planting in the spring it is better to make the final pruning of roses in advance, so that to not cut again after planting.

The depth of planting depends on the location of the graft - its peak should be located at the soil surface. The pad must remain at 3 to 5 cm below the soil to prevent its growth.

The distances for planting roses in different groups depend on their purpose. Miniature roses are planted in borders off 10 to 20 cm; roses with small flowers and decoration roses - 30 to 40 cm, large-flowered, floribunda and hybrid tea roses, 40 to 60 cm, shrub roses in park strips 70 to 80 cm apart; park shrub roses in free groups off 100 to 150 cm, wild rose bushes scattered single - of 2.0 to 3.0 m, climbing (creeping) roses off of 2.5 to 5.0 m, tall roses - of 0.75 to 1.0 m apart.

### **3.4. Maintenance of Roses**

Current treatment involves digging of soil, loosening and removing weeds.

Feeding is done with both organic and mineral fertilizers. Hybrid tea roses and climbing types especially need fresh soil and a lot of nutrients.

Watering the roses during the growing season is usually performed by sprinkling with sprinklers. It is best to be watered less frequently and abundantly in order to dampen better the

root system.

### **3.7. Pruning of Roses**

The pruning the roses depends on their biological characteristics. This is the most important and obligatory prerequisite for a lush growth and profuse flowering of roses. It consists of reducing the part of the roses above the surface by removing old branches and significantly shortening of the remaining live branches. The cuttings must be with the smallest possible surface (horizontal or slightly inclined) and towards the bud. We cuts near the well-developed outer bud. Plants, however, immediately seek to restore the imbalance with maintained to its original form root system and consequently to replace missing shoots by vigorous growth of new shoots. Since rose bushes bloom on the annual shoots, the more vibrant and lush these shoots are, the more abundant is the roses blooming, and the stronger the rose bush, the more numerous the stems.

Whatever the type of the roses, clearing is required. To do this many times during the year we removed the old branches, cut to base any damaged, diseased, broken and weak stems as well as the newly emerged wild shoots.

In the first year after planting pruning takes place for cultivation. Then the bush is formed usually of 3 to 4 main stems, cut low at 3 to 5 or more buds. Each stem sprout mostly 2 to 3 leading shoot, most of which end in flower buds. The second line of shoots which emerged later also end in buds, some of which are allowed to flourish while others are pinched. When we promptly clean the overblown blossoms a well-shaped shrub with ripened shoots occurs in autumn.

### **3.6. Preparation for the winter period and the end of winter period**

We have to prepare for the winter period the roses which do not tolerate cold temperatures. Particularly sensitive are hybrid tea roses, whose branches are killed completely at minus 17 to 20 degrees C. We proceed to this preparatory activities in late October to early November in dry weather. Creeping t park and botanical roses are not covered for the winter because they are cold resistant.

Preparation for the winter is done by the end of October to early November. While the preparation for the end of winter periods is done from 15 March to 15 April. The accumulated soil, leaves and other materials on plants have to be carefully removed to avoid destruction of buds or breaking the growing shoots.

### **3.7. Pests and diseases of roses**

This manual addresses the insect pests and diseases on roses

#### **4) Flowers**

Ornamental grasses are for styling and colorful detail formation of the green areas. Depending on the morphological features, on the life length of the flowers and their application, the main groups of flowers that are used in green areas are:

- Annual in nature or use (summer seasonal flowers) - annual grasses and associated grassy crops which accompany them for one season use which can be beautifully flowering and leaf decorative;
- perennial, used as a two-year crops (spring flowering) - biennial herbaceous plants can be with a two-year life cycle or are perennial in nature, but they have their best effect in the second

year;

- perennial (pinnate flowers) - perennial herbaceous plants or semi-shrubs for multi-seasonal effects, some of which retain their leaves green in winter and others survive the winter only in their root system;
- Bulbous plants whose parts are underground bulbs (annual and perennial), tubers and rhizomes which are characterised with a spectacular blooming mainly in spring and early summer and they are frost- resistant, semi-frost resistant and non-frost resistant;
- decorative (ornamental, pinnate) grasses which are mainly perennial with long (fixed) seasonal and some have all the year round a decorative effect;
- Herbaceous vines that are climbing, pending (hanging) , remontant and crawling ornamental plants with long supple stems which resemble vines, suitable for vertical gardening.

#### **4.1. Seasonal summer and spring flowers**

- Depending on your height the seasonal summer and spring flowers are divided into the following five groups: giant, high, medium high, low and miniature;
- According to their attitude to light, they can grow in moderate light and can be resistant to shade;
- According to their relation to moisture they can grow in wetland, semi-wetland or can be drought resistant;
- Depending on their preference of the soil, the plants are grouped as follows: for loosened garden fertile soils, for light sandy nutrient soils, for sandy loam stony soils, for any humus soils, sandy clay to light sandy loam and light calcareous sandy loam soils;
- Summer flowers bloom from May to October;
- Biennial species bloom in the periods: March to April, April to May, May to June, June to August, and from July to August.

#### **4.2. Perennial (pinnate) and bulbous flower**

- Depending on their height perennial flowers are classified in the same groups as seasonal flowers, namely: giant, high, medium-high, low, miniature and creepers.
- Depending on the height of the bulbs and tubers (frost and semi-frost resistant) they are: high, medium-high, low and miniature.
- Depending on their reaction to light, perennial flower and bulbs are divided into: resistant to shade, semi-resistant to shade, moderate resistant to shade and light-loving plants
- According to the requirement to the soil conditions, plants are divided as follows: plants which show preference for rich soils, preferring semi-rich soils, preferring sandy loam soils, with a preference for loose garden soil requiring sandy loam and light sandy soils, preferring calcareous soils.
- Depending on their reaction towards moisture the types are: drought resistant, growing in moderate wetlands, or in wetlands, aquatic crops and soils along places near streams and rivers and crops with floating leaves and flowers
- The perennial species bloom throughout the year depending on their type
- Different types of bulbs bloom in all seasons.

### 4.3. Decorative grasses

→ Depending on their height they are distributed as follows: giant, high, medium-high, low and miniature.

→ Depending on their reaction to the light they are: light-loving plants, moderate resistant to shade and resistant to shade, .

→ Depending on their reaction to moisture, they are divided into: drought resistant, growing in moderate wetlands, or in wetlands, wet soil species on the coasts and in the water and ecologically plastic.

→ Depending on their reaction to the richness of the soil are divided into: species which require rich soils, which favour medium rich soils, which prefer poor soils and those for calcareous soils.

### 4.4. Herbaceous vines

→ According to their life-cycle and methods for their growing these plants are annual and perennial.

→ According to their length (height) of the stems, they are divided into: long (5.9-6.0 m-high) of medium (medium-high 2.5-3.0 m) and low (ample plants to 1.0 m).

→ According to the method of attachment they are: climbing, creeping, remontant and crawling and hanging (ample).

→ According to their reaction to light they are: light-loving, and growing in semi-shadows and shadow resistant.

→ According to their reaction to soil conditions they are sensitive and semi-sensitive

#### – **Ways how to use grass-flowering plants**

Using grass-flowering plants in colour landscaping depends on their life cycle, their ecological requirements and morphological features. It may be for one season (summer or spring) - interchangeable and multi-seasonal - stationary.

They are used as solitaires (single plantings) as curbs or arabesques (intricate ornaments with complex geometric spirals, circles and lines) in beds of colored shapes, mixed borders for groups and arrays to form bordering of tree and shrub groups to build undergrowth for color design of walls, for horizontal type of plant cover, for planting in flower vases and for planting in hanging containers.

#### – **Planting**

The variety of perennial flowers thrive on permeable sandy loam soils with medium humus content. Rigid and porous soil types are suitable for flat root systems that develop a depth of 10-15 cm. Species growing in the deep root system (up to 40 cm), these soils should be improved. For most types of seasonal flowers most suitable deep (25-30 cm) humus sandy loam soils with good nutrient content.

With the main (pre-planting) fertilization for perennial flowers we introduce the full norm of organic fertilizers and a great deal of the mineral fertilizers for a certain species. With pre-planting fertilization we introduce 1-2 kg per decar nitrogen, phosphorus and potassium fertilizers in the ratio 2:4:1.

The main task is to improve the fertility of the soil, to destroy the weeds and to eliminate pests. This requires the precise tillage of the areas provided for planting flowers.

Best time for planting perennials flowers is soon after their overblowing. The plants blooming in spring should be planted in late spring (in early June) and summer- and the plants blooming in autumn - from August until November or in the spring – from March to May. Spring blooming bulbs and tubers which are frost-resistant flowers (daffodils, tulips, crocuses, squill) are planted mainly in early autumn (from the last week of August to end of October), so they can take root in early spring and begin their growing.

Non-resistant to frost tuberous plants flowering in spring (gladiolus, dahlias, kettle) are planted in early spring. Frost-resistant bulbs flowers with early blooming- bulbs are collected in June-July in a certain sequence: first the bulbs of squill and kolhikum and then tulips, hyacinths and daffodils. The bulbs are removed when the leaves turn yellow. Before planting large flowering bulbs and tubers are separated from the small small. In the spring planting begins as soon as the soil drains and lasts until the beginning of the intensive growing of the underground part.

Swamp plants are shipped in special containers or baskets (gliders) with normal (not dry) root ball. Water lily stems must be long at least 5-6 cm and are well-developed buds.

Planting is done during the cooler hours of the day or in cloudy weather. If the soil is dry, we should water one to two days before planting. After planting, the soil around flowers is stamped and abundantly watered with watering can or hose, but we should be careful not to clog it (2-3 times l/m<sup>2</sup> 1.0-1.5).

The depth of planting depends on the size of the root system and planting seasons. The main requirement is that the neck of the planted plants should remain at the level of which it was located before removing.

Annual ornamental grasses are sown annually and thick in shallow furrows. To obtain a more rapid effect it is recommended to plant the seeds in the second half of March or the first half of April in small pots, which initially are put on pads in warm places. The seedlings are planted in May in the form of small root bales.

Perennial ornamental grasses are propagated and planted in a permanent place in two ways - by seed or vegetative.

The distances for planting perennials, bulbs and tubers flowers are determined depending on the options for treatment of longevity and size of tufts. They should be planted in checkerboard pattern to avoid long visible lines.

#### – **Ongoing maintenance and care of flowers**

The general care of the flowers, despite their great diversity, are as follows: fertilizing, weeding, loosening, fixing, hoeing, watering, pruning overblown flowers, change of plants, filling, control of diseases and pests, and others.

#### – ***Mechanical tillage***

The mechanical tillage in the process of maintenance aims to regulate water and air regime of the soil. Through it we destroy weeds.

Hoeing is done only at the higher annual and biennial pinnate flowers. As flowers generally have shallow root system, care must be taken to prevent injury to adjacent surface roots. Therefore the depth of processing is 3-5 cm in low summer and biennial flowers and respectively 10-15 cm for perennials.

Dusting is done 6-8 times per year at representative maintained sites and hoeing is done 4-6 times. Between hoeings we recommend loosening of the soil, especially when irrigation is

abundant.

Crumbly soils are necessary as agro-technical operation which is important for retaining moisture in the soil to maintain its normal air mode and prevent weed growing. For spring and summer flowers the soil is loosened regularly in the season immediately after irrigation or after a heavy rain at a depth of 4-5 cm to destroy the formed soil cover. In perennial flowers the soil is loosened to a depth of 5-8 cm, and right around the plant - at a depth of 2-3 cm

#### – *Weeding the flowers*

Weeding begins as early as possible in the spring and is done systematically throughout the season at any time of day. It is wise to weed while loosening and best after heavy rain or after watering. Weeds should be removed by the roots or cut as deeply as possible, then collected and destroyed. Figural flower carpets are weeded without loosening.

Weeding is done primarily by hand, in wet weather, in order to eradicate weeds. The use of herbicides is dangerous because the flowers and weeds have similar in biological characteristics ..

#### **4.7.3. Watering**

It is particularly important for regulating the water and air balance of the soil, it keeps the flowers to look fresh and creates favorable conditions for their development.

The flowers are watered regularly, especially in drought when the soil is permeable. After planting the flower seedlings of the summer flowers we water daily and thoroughly, and when the plants are well established, watering may be limited to 1-2 times a week. Perennials flowers are watered more frequently during the first year after planting. No need of watering for the types resistant to serious drought. A small amount of watering is needed also for the plants, moderately resistant to drought. Hygrophyte species must be watered often . In dry periods perennial flowers should be watered after they are overblown.

#### **4.7.4. Feeding**

Feeding is needed throughout the growing season as the primary and pre-planting fertilization are unable to fully meet the needs of plants for nutrients. Regular feeding is needed for selected crop forms and species requiring rich soil. Feeding is also necessary when the soil is not fertile enough.

Feeding is not recommended for the rock flowers, it is better to change the surrounding soil. It is not recommended for well developed plants, as this may increase vegetative growth and reduce flowering, unless the soil is fertile enough.

For feeding we used both mineral and organic fertilizers in dry or liquid form. Plants begin to feed only after their roots grow and they begin their active growth and the formation of vegetative organs. Then we use mainly nitrogen.

#### **4.7.5. Other cares for the flowers**

Clipping is used in flower carpets and flower borders.

When pruning the flowers we should consider the flowering branches.

Timely re-planting and separation of plants is mandatory for maintaining perennial flowers, which thus rejuvenate. Over time, plants grow and feel a lack of nutrients and moisture. That is why it is necessary to dig up the old clumps and split them in parts with 3-4 buds. Separated plants are

planted in new places. The best time for transplanting of species flowering in spring is the beginning of autumn, and the species that bloom in summer and fall - in spring.

Immediately after they are overblown the flowers and flowering stems are removed, in order to prolong flowering, as well as for aesthetic reasons. When the overblown flowers are eliminated in time, some species bloom again, and many flowers can bloom until fall.

The top part of the stems or shoots growing in length from 1.5 to 2.0 cm are removed in order to maintain growth and development of low-growing dormant buds. Thus we stimulate lateral branching, the plant becomes more compact and blooming more abundant. The lateral branches (pasinki) of the stem are removed timely.

In order to have an aesthetic effect during the growing season when some flowers lag in their development or die or certain plants appear with different flowers they should be replaced with new ones.

Due to the biological characteristics of the flowers at the end of their life cycle they have to be uprooted and removed. Annual and biennial flowers, used in lawns once every year or in two years are replaced by annual and biennial in the opposite sequence. Waste is removed.

#### **4.8. Vertical gardening**

Plants that do not have self sustainable vertical growth but spread onto the surface of the ground or rise up using special devices are suitable for vertical planting. We mainly use two types of plants - vines and ampel (pending) plants. Depending on the method of attachment vines are climbing, creeping or remontant.

For landscaping of supporting walls, fences and low walls we use climbing vines and remontants, capable to raise a 3.0 to 4.0 m in height. The facades of tall buildings are shaped very easily with ivy. Pergolas, rotundas, gazebos and garden entrances are shaped with openwork cover planted with vines and climbing shrub whose length exceeds their height and their branches are thick and densely leaved. Openwork fences and planted mainly with remontant bushy vines. Pillars are planted with vines or creeping bushes.

Bushy vines are planted almost as ordinary trees. Their seedlings should be with well developed, compact and undamaged root system. They are transported wrapped around pegs to prevent intermingling. Planting pits are usually 60/50 cm in size and depth of 80 cm, and the distance to the supports is 30-50 cm. Grassy lianas and herbaceous ampel plants are planted usually in pots or boxes for planting on balconies, terraces and windows.

#### **4.9. Pests and diseases of flowers**

The manual covers insect pests and diseases in flowers

### **IV. Events for maintaining non-vegetative structural elements in green areas**

The non-vegetative structural elements are of two main types:

- paths, playgrounds and other paved areas
- architectural elements and equipment

#### **1. Paths, playgrounds and other paved areas**

Lane network in green areas consists of walking lanes, cycling and transport pathways and playgrounds. Walking and cycling lanes are designed for movement and relaxation for visitors. Transport pathways and sites are used for movement and parking of service vehicles and mechanization.

Maintenance of paved areas includes cleaning, current repair and overhaul.

Current repair of pavements is determined by the category of maintenance, type of material from which they are constructed and the intensity of their use.

When damage occurs over a large area a major overhaul is done in which new tiles are arranged in these areas .

In supporting stone and concrete curbs 3-4 times a year we remove overgrown herbaceous plants and if there are sunken, broken or distorted elements they are rearranged or replaced.

Major renovations are done at a period of 20 years or in reconstruction of the alley network.

Grass curbs are cleaned 3-4 times a year and the lush growing grass is cut, observing the design width of the pathway. Overhaul is done in 5-6 years depending on the category of the site.

Ongoing maintenance of ditches and culverts mainly consists of removal of vegetation and debris. This must be done in the spring and in the autumn to ensure the performance of their functions

The current repair is to restore a sunken and twisted slabs of stone used for lining ditches while the green ditches are recovered annually and cleaned 3-4 times a year, mainly in spring and autumn.

Maintenance of the steps is analogous to the maintenance of alleys filled with the same materials. What is important for steps is the regular monitoring of their state in order to ensure their safety. We must continuously monitor them in winter so that they are free of ice and sanded.

## **2. Architectural elements and equipment**

### **2.1. Maintenance of pools and facilities**

Maintaining water areas and facilities consists of cleaning, preparation for the winter and spring seasons, maintenance and overhaul.

In addition to regular cleaning of water from thrown waste and fallen leaves, we should also clean settling tanks, drains and other engineering elements that support the proper functioning of the equipment. We lean and bottoms and sides of fountains and pools as well.

Subject of winter preparation are fountains, basins, water mirrors and water cascades.

Fountains are prepared for the winter by covering with wooden or tin structures.

Water facilities with larger dimensions are covered with insulation, halm, straw and other. Before winter the water is cut off and drained.

Preparation for the spring is done in early spring - the equipment coverage is removed, if necessary repair is done, insulating material is removed, and facilities are washed .

We should carry out periodic inspections of the basis on which the current repair is accomplished for the outside appearance or the installations.

Overhaul is performed when the equipment can not perform its function.

In the presence of aquatic fauna and flora we apply adequate cares. Fish is provided with food and ice is broken periodically. Waterfowl are gathered at appropriate places.

The plants that are in the water areas, are prepared for the winter by draining the water. The preparation includes covering with a layer of leaves and straw.

## **2.2. Maintenance of park furniture**

### ***Wooden architectural elements***

These are mainly benches, pergolas, gazebos and playground facilities. Maintenance consists of repair and renewal of worn out joints. It is performed for specific needs.

Overhaul or replacement is done if necessary when parts or structures cannot serve their purpose.

Impregnation takes place in spring and autumn, or only in the autumn, depending on the category of the site.

Facilities with visible grain are covered with hot linseed oil, azure polish or a combination thereof, depending on the requirements provided in the project according to which they are constructed.

Facilities for children require continuous care for their construction and flooring beneath them to ensure their safeguarding. The way for their management is regulated by Decree № 1 of 12.01.2009 on the terms and conditions of the construction and the safety of playgrounds.

### ***Metal architectural elements***

Partial repair is done at ad hoc basis, it is for the separate parts in order to continue the normal use of the device.

Overhaul or replacement is made in full wearing out or greater damage, in which the device cannot perform its function.

The painting is done in dry weather at least once a year. For new parts a ground layer is applied.

Architectural elements, made of stone, concrete or other building materials due to their greater durability require mainly current repair and cleaning. The current repair consists of patching and replacement of individual parts.

Current repair of underground equipment of the technical infrastructure is done not only during the operation, but also every spring before putting them into action. We inspect and remove any detected defects. Overhaul is accompanied by a general deterioration or major damage compromising the entire system.

## **Part II. Defining quantitative criteria to maintain green area per unit**

Defining quantitative criteria to maintain green space per unit is based on the types of work to be performed during the current maintenance of the components of the green areas. The work depends on the composition and content of the respective elements. In general, the elements of the green areas are differentiated into two groups:

- Group one – vegetative elements

This includes lawns, flowers, roses, shrubs and trees, which are the main and most important part of the green space.

– Group two – non-vegetative elements

This includes lane network, architecture elements and facilities which, with the exception of lane network, are extremely varied in composition and specific participation in specific projects.

In this manual deals in details with all vegetative parts of park areas, differentiated by biological signs and lane network, as a key element with the highest functionality and significant maintenance costs. The other non-vegetative elements that are related to the furnishing of individual objects, due to their extremely diverse composition and minimum maintenance costs are not covered by this guide.

The main methodologies for the definition of quantitative indicators in maintaining green area per unit is the use of natural indicators relevant to the maintenance of individual components according to their biological characteristics and function. Technological standards for maintenance of park facilities are directly connected with the categorization of green space in intensity of maintenance.

The technology cards on individual aspects of green areas determine the type, composition, repetition and volume of work that must be done to maintain the relevant elements. This differentiation by technological charts is based on differences in labor consumption of the works stipulated in the existing labor standards. Based on the types of work and their incidence we define certain materials and equipment necessary for the maintained elements of green areas.

The workload and their incidence are set for average soil conditions and optimal cost of materials and equipment for a total of 20 technology cards as follows:

- Technology card No.1 - Maintenance of free lawns
- Technology card No.2 – Maintenance of undersized lawns up to 600 m<sup>2</sup>
- Technology card No.3 – Maintenance of lawns with small patches of vegetation
- Technology card No.4 – Maintenance of lawn strips up to 6 m
- Technology card No.5 – Maintenance of grass borders and old lawns
- Technology card No.6 – Maintenance of grass borders alongside flowers and other species
- Technology card No.7 – Maintenance of grass borders edged with concrete strips
- Technology card No.8 – Maintenance of cover vegetation
- Technology card No.9 – Maintenance of flower formations of summer or seasonal flowers
- Technology card No.10 – Maintenance of flower formations of flowering bulbs
- Technology card No.11 – Maintenance of flower formations in mosaic forms
- Technology card No.12 – Maintenance of perennial (pinnate) flowers
- Technology card No.13 – maintenance of roses

- Technology card No.14 – Growing single trees in lawn areas
- Technology card No.15 – Growing trees in clusters and arrays
- Technology card No.16 – Growing trees along streets and boulevards
- Technology card No.17 – Growing bushes – single plants or in clusters
- Technology card No.18 – Maintenance of hedges
- Technology card No.19 – Maintenance of paved pathways and playgrounds
- Technology card No.20 – Maintenance of unpaved pathways and playgrounds

The structure of trees and shrubs in the technological cards is determined by age group, according to the current state of the constructed objects.

For the determination of the required labor costs we have used labor standards for landscaping work - Collection № 9. For seed materials and for the mineral and organic fertilizers we have used average rates and standards. For machines and mechanization we have considered specialized equipment currently used in the park construction. Transportation costs should be calculated according to the specific conditions on the basis of given for materials in the technology cards and the form of transport and transporting distance are determined according to the rates of transport.

In the technology cards in addition to current maintenance for each item, according to the intensity of support, we have given the type and amount of work for their resumption.

The technology cards do not treat some specific elements of green areas as rockeries, water and other areas, the maintenance of which should be prepared by individual calculations.