THE TREES PROTECTION PROJECT, THAT IS HOW TO PLAN, IMPLEMENT, ENFORCE VALID PROTECTION OF THE TREES IN THE INVESTMENT PROCESS

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Introduction

As in many other countries, in Poland the largest urban trees stands losses, are at the “contact” of the vegetation and the technical infrastructure. These losses occur during the investments, modernisation work, of e.g. streets, and the ongoing repairs to the urban technical infrastructure. Many conflicts can be avoided or reduced by the natural and the technical tasks coordination within the integrated design and implementation of the investment. According to the analysis of the problem, the cause of large losses of the trees stands in the Polish cities is the lack of the relevant decision-making tools, such as guides, guidelines, standards and norms taking into account the development potential of the trees at different stages of the investment process. This results in taking wrong decisions, especially in terms of the location of the trees in relation to the ground and the underground infrastructure. The lack of consideration of the spatial parameters affecting maturity of the tree prevents from obtaining a full period of effectiveness, the
so-called ecosystem services, resulting in the ecological, social and economic losses, as well as the lowered quality of life for the residents. The lack of the necessary information is observed both in the assessment, valuation and selection of the trees in the period before the investment, at the stage of the trees protection and the organizational strategy of the executed works, and in the stage providing the necessary caring activities of the trees after the construction stress. The issue is so important to be covered by the international research programs in the context of the urban policy of the EU, such as the research programme: COST Action 15, “Improving relations between technical infrastructure and vegetation, 2006”. Within the COST programs, considerable importance involves the exchange of experience and technology solutions entering the investment processes of the individual European countries. The solution to these problems is in fact inter alia the basis of the eco-efficiency sustainable urban development. In reference to the current trends in Europe within the IGPIIM research project, the Protection Program was developed, which is a tool for the management of the investment process of the tree stand. It includes three monographs: “Management of the tree stand”, “Organization of work on the construction site” and “Design solutions”.

Aim and scope

The aim of the project was to assess the possibility of the implementation of the EU urban policy priorities of the eco-efficiency on the example of the urban investment areas, which led to the development of the guidelines to increase the effectiveness of protection, security and management of the trees throughout the investment process. The added value of the work was to develop the guides explaining the rules and ensuring proper management of the urban trees in the investment process. These guides, as the necessary tools to protect the trees and rationalise the design and the execution works, can contribute to the rationalisation of the provisions relating to the public procurements in Poland. The additional result of the publication of the Trees Protection Project (TPP) is to be the optimisation of the ecosystem provided by the trees for the urban environment, and raising the standards of the cities and life of the residents.

Within the research, based on the comparative analyses and the request of the list of the causal link, the summary of the problems concerning the
area between the urban trees and technical the infrastructure, in terms of the relationship:
– morphology and physiology of the trees and the conditions associated with the change in soil environment caused by construction,
– trees and aboveground and underground infrastructure networks,
– trees and buildings,
– trees and road infrastructure.

These solutions were developed to assure the normal development of the trees taking into account their biological development requirements and the course of the physiological processes.

The practical aim of the work was to increase the efficiency of the economy of the natural resources, especially the urban areas with the trees and a wide informative and educational program for different social groups (professionals, policy-makers, population).

The innovative aspect of the work involves the causal link presentation of the issues, which allows putting them into the wide practice by naturalists, technicians, and economists at the various stages of the investment activity.

Methodology

Due to the complexity of the interactions of the natural and the technical issues, the basis of the research works was the comparative analysis of the available information from both the literature and the domestic and foreign research units, developing the analogous issues. The important source of information involves the results obtained from the research task of the Institute of Spacial Management and Housing no. 8 and the previous research, the conclusions of which were used to meet the needs of the design and the executive stages. Based on the obtained information, the analyses were carried out under the logical tools of causal link concluding for the specific problems solutions and checking the advisability and the possibility of introducing the specific solutions in the Polish conditions in the urban areas.

In accordance with the adopted plan, the first stage of the research was to identify the causes of the dying trees growing at the “contact” with the technical infrastructure, such as the aboveground and the underground infrastructure network, the buildings and the road infrastructure, with the analysis of the legal and the technical solutions applied worldwide in order to
increase the efficiency of the ecosystem services derived from the presence of the trees in the urban structures with high degree of urbanization. The carried out analyses were to enumerate the problems, taking into account the global solutions adapted to the Polish conditions.

1. The analysis of the collected materials included both the results of the works of the ISMH, and the other Polish and foreign scientific bodies, including the results of the works of COST Action research program: “Improving Relations between Technical Infrastructure and Vegetation” 2006, executing the EU’s sustainable development policy in the field of the environmental urban areas. This analysis included inter alia the scientific developments from different European countries such as:

- „Tree Quality BMPs for Developing Wooded Areas and Protecting Residence Trees”, „Construction Damage Assessment Trees and Sites, Tree Quality BMPs for Developing”, „Wooded Areas and Protecting Residence” (Coder 1995, 1996);
- „Reducing Infrastructure Damage By The Tree Roots: A Compendium of strategies" (Costello Jones 2003).
- „Preserving Trees In Construction Sites. DPR Street tree preservation – protection and planting standards” (Dicke 2004)
- „Best Management Practices Managing trees During Construction” (Fite Smiley 2008).
- „Richtlinien zur Wertberechnung von Bäumen, Vereinigung Schweizerischer Stadtgartenreien und Gartenbaumarter” (VSSG, 1991)
- „Up By Roots Healthy Soils and Trees in the Built Environment.” (Urban J. 2008) and many others.

A number of foreign guides of the rational planting of the trees in the cities using new technical solutions were analysed, inter alia “Planting Beds in the City of Stockholm A Handbook GH100322”(Alven et.al., 2009) and others.

2. The analysis of the laws covered the regulations on the protection of the trees in the cities in Poland and other European countries along with the comparison of operation of the individual legal acts.
3. ** Enumeration of the problems to be solved** resulted from the analysis the works on the issues of point 1 and 2. It covered the specification of the problems to be solved within the assessment of the existing status, the barriers limiting the development of the trees in the cities in Poland and abroad as well as the directions to increase the innovation efficiency of the ecosystem services generated by the cities trees stands.

4. **The development of the guidelines to create The Trees Protection Project** in the form of three monographs. The publications contain up-to-date knowledge and practically demonstrate the solutions based thereon. The substantive basis for the works involved the studies and the research works, especially the comparative analyses of the solutions of the particular problems and the development of the model solutions adjusted to the Polish conditions, which led to the development of the Trees Protection Project.

**Results**

The effect of the carried out analyses was to develop the Trees Protection Program, which is supposed to be a helpful tool in solving the problems arising in the area between the trees and the technical infrastructure. The carried out comparative analyses and the collected informational materials allowed to conclude in terms of causal link.

The analyses showed that the problem of inadequate protection of the trees on the construction site is multi-dimensional and is not just limited to the organizational determinants related to the investment process. The obligation to protect the trees is defined precisely neither in the legal acts (the Act on the nature protection, the Environmental law, the Construction law) and it is easy to avoid liability for damage as a result of the executed works. The situation is exacerbated by the fact that the effects of the damage are visible right away or even a few to a dozen years after the end of the investment. The problem also involves the attitude of the society, both the investors and the designers, government officials, contractors do not have enough knowledge to apply the solutions for the effective protection. They are not able to predict the consequences of the taken locational decisions and application of the proposed technologies in the context of the effect on the life of the trees and the chances of their safe life. The lack of the tools to allow effective enforcement of liability for the unjustified loss of the trees
or their damage causes lack of motivation to search for new solutions and increases the number of the lost trees. The issue of the protection of the trees in the investment process is not sufficiently solved in the publications. There are ineffective practices introduced decades ago, which should be reviewed and upgraded in accordance with the available technologies and capabilities, which are introduced by the current status of the technological knowledge. A number of the methods were implemented on the market (e.g. a number of the types of water-permeable surfaces), while others became the standard (such as the controlled jackings).

The monographs, which are the result of the research project, present the innovative solutions for use in places with difficult relationships between the natural and the technological environments, which include both the present procedures to be followed and the solutions directories.

The Trees Protection Project contains the data that can provide the basic information to take the rational decisions to protect the trees stands, and therefore the natural landscape and social values of the urban areas. The work is divided into two parts. Management of the trees stand, Organization of the works on the construction site, The design stage, The selected design solutions.

Fig. 1 The scheme of the Trees Protection Project in the investment process

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I. The first part (Management of the trees stand) contains a number of the requirements of development of the trees and their qualifications to be adapted or removed at the stage of planning and designing of the investment. Based on the guidelines contained in the work, it is possible to assess the trees and their chances to survive. The work contains the analysis of the problems with management of the trees stand on the construction site and the qualification criteria were developed to leave, replant and remove the trees in the Trees Protection Project.

The analysis of the problems involved the issues of health assessment and the predictions for survival of the trees, the influence of the development phase of the trees on damages, the specification of the species tolerance, and the development chances and the trees tolerance for damages associated with the construction works. In addition, the indicators for the assessment of the scope of mechanical damage, resistance to wood rot of the individual species, the species tolerance to mechanical damage and cutting the roots and tolerance for replanting were included. At work covered the critical distance to remove the tree roots in the context of losing its stability. In addition, the species tolerance to flooding and compacting the soil, higher pH and wind and breaking resistance were analysed.

The correct assessment of the chances of development of the trees requires a determination of the range of the root system and the assessment of the structural factors limiting the surface of the root development and awareness of the stressing factors on the construction site such as insufficient or oxygen availability, density and pollution of the soil, adding and removing the topsoil and response to pathogens and pests. The work discussed these factors and their influence on the chances to survive by the trees on construction site.

Furthermore, the work discussed the optimal scope of the trees protection on the construction site in the design documents that allow to protect the trees. These are inventory, the trees protection project on the construction site (management of the trees stand), the architectural and construction design, the land development design and the executive design with the technical specifications. These documents indicated the methods of assessing the suitability of the trees to protect and designate the protection zones of the trees to be left during the construction works.

The guidelines and indicators contained in the work allow to:
- identify the most valuable natural values within the investment,
- assess the chances to survive by the trees and their development after completion of the works,
– specify the range of the root system,
– develop the procedures for specification of the influence of mechanical damage of the trunk and crown roots on the chances to survive by the trees,
– assess the influence on the life of the trees: compaction, changes in the ground level, lack of oxygen, humidity, restrictions of the root space, microclimate changes. In addition, the field method for specification of the type of soil,
– the influence of mechanical damage of the roots on keeping the stability in the ground,
– the influence of the species tolerance and involved with the development stage on resistance to the stress factors on the construction site was included.

The knowledge of the influence of the stress factors is to allow at the planning stage:
– select the trees with the highest chances to survive,
– properly qualify the trees on the construction site to be left, removed, replanted,
– specify the protected zones (the Root Protection Zone) for the trees selected to be left,
– adjust the caring treatments to the species and the type of damage, etc.

The development was complemented by an extensive species tolerance on the selected factors developed based on the available researches of different authors.

II. Part two “Organization of the works on the construction site” contains the procedures for the protection of the trees in the investment process. They were divided into the proposals for the engineering solutions of the natural rehabilitation activities and for proper protection.

The engineering solutions include:
– technical standards of construction of the protection fence,
– guidance regarding the determination of the protected zones with the educational functions,
– temporary construction technologies of the communication solutions for protection – temporary roads,
– principles of construction of the root screens,
– non-collision conditions of execution of the works using the trenchless technologies, such as jackings (molding, tunneling).
The natural solutions (preventive) defined as:

- mulching,
- watering,
- the principle of cutting in the crown of the tree without causing additional stress to the tree,
- mycorrhizaling,
- assembly of bindings in the crown of the tree,
- the rules for the clean cutting of the roots,
- exchange, loosening the soil,
- the crown shading,
- the rules for the manual execution of the works,
- protection of the root systems against density,
- protection of the root systems against pollution.

The work indicated the guidelines for proper execution of the treatments and the unacceptable activities directory.

III. The third part “Designing in the environment of trees”, provides the technical trees-friendly solutions and the methods to improve their habitat conditions.

The monograph proposed the review of the methods to improve the habitat conditions for the development of the trees and minimize their damage within the investment at the design stage. The basic issue discussed here covered the demand on the soil of the newly planted and the existing trees. Based on these analyses, the directory of the methods to facilitate the development of the trees in difficult urban habitat was suggested. These methods include the proposals of the non-collision technology of the executed works, such as controlled jackings and the identified design solutions, including determining the optimal size of the bowl, the methods to avoid damage to the infrastructure by the trees, forming the surface within the root system of the tree. In the latter case it is important for the roots to have access to water and oxygen necessary for their growth, therefore the summary of the permeable surface, such as porous concrete and asphalt and paving of cobblestones type, were developed. In addition to the water-permeable wearing surface and the substructure, it is also important to shape the trough and assembly the flanges in the least collision method to the roots, hence the proposal for the directory of the alternative outskirts and different solutions as curbs of the bridge type and the guidance when to apply the surfaces without curbs or overhead surfaces (e.g. platform gratings or ramp pavement). The type of the suspended pavement involves
the cellular structures or the structural substrates, the rules of shaping of which were discussed in the work. Furthermore, the rules of minimizing the influence of the proposed communication solutions on the life of the trees and their chances to survive, such as the underground systems for root development, irregularly shaped surfaces, gulf to slow down the traffic, raised crossings, islands or road markings as a way of avoiding a collision of using the trees. It also includes the fencing-point foundation and designing of the shallow foundations.

These solutions also take into account the issues of water management in the urban areas and the opportunities to improve its water balance.

The present monographs, which are considered as the Trees Protection Project, are the set of the rules for good management of the urban trees in the investment processes and tools that have the potential to contribute to the effective protection of the trees in the investment process but also to rationalize the provisions and create the standards in Poland. The development is the technical training material for urban planners, landscape architects, civil servants, contractors, inspectors of supervision of all industries and others liable for management of the trees stands in the urban areas. Due to low awareness on the effective protection of the trees in the investment process involving all participants, they will be a learning tool allowing the dissemination of good practices, overthrowing stereotypes and improving communication between the participants in the process of planning, designing and implementing the investments. Only improvement of the level of knowledge will allow for effective oversight over the trees protection. It can be implemented only in the situation where at all stages of the design process the trees protection supervisor is present (landscape architect, dendrologist, arborist or other specialist with the appropriate level of knowledge) and the stage investments inspector in this area. The set of the publications, which resulted from the carried out researches, will allow both to raise awareness for the trees protection and indicate the procedures that allow for the effective protection of the most valuable natural values in the area of the investment.

**Conclusion**

In order to coordinate the parameters for the future development of the technical solutions of the adjacent infrastructure, it is necessary to provide a series of information in the form of guides, guidelines and norms containing
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the information about the development processes of the trees and the new techniques and technologies to solve the collision problems. The described research works involved the development of the Trees Protection Project at all stages of the investment process: planning, designing and construction. The Trees Protection Program allows to provide the optimal management of the trees and other elements of the environment in the areas of the urban investments. The development contains the comments and the indications for spacial planning, designing and implementation of the urban investments in the field of the technical, agro-technical and organizational indications. This information is coordinated with the EU guidelines in the field of spatial policy and sustainable development, and with the provisions of the Construction Law, the Law on the Nature Protection and the Environmental Law.

In this context, the Trees Protection Project:
- allows to provide the optimal management of the trees and other elements of the environment in the areas of the urban investments,
- is the tool containing the indications for spacial planning, designing and implementation of the urban investments in the field of the technical, agro–technical and organizational indications,
- provides the spacial indicators and the design solutions to protect the trees on the construction sites to facilitate the works in the designing and the constructing units.

The researches results containing these solutions were developed with particular attention to emphasize the necessity to assure proper trees growth taking into account the biological and the physiological processes. Implementation of the developments with the reasons thereof can become the inspiration to search for the innovative solutions in the areas with difficult relationships between the natural the technical environment during preparation and realization of the investments.

In order to understand the development of the trees and their importance in the urban environment, the TPP provided the basics information on physiology and biology of trees and shrubs and the soil environment, and the benefits (ecosystem services) derived from the presence of the trees in the urban structures.

The TPP allows for increasing the efficiency of the natural resource management, especially the trees in the urban areas and the evidence base to implement a comprehensive program of education and information for various social groups, not only related to the investment of the professionals and the decision-makers, but also the investors and the residents interested in maintaining the trees in their neighbourhood.
The innovative aspect of the work involves the causal link presentation of the issues, which allows putting them into the wide practice by naturalists, technicians, and economists at the various stages of the investment activity. In addition to the publishings, the obtained results will be implemented in the form of the technical standards and popular as a small booklet of information and learning for the municipalities and the cities residents.

The results of the work will be the technical training material for urban planners, landscape architects, civil servants, contractors, inspectors of supervision of all industries and others liable for management of the trees stands in the urban areas. For the planners, designers and contractors, the data included in the guides will be the basic information to take the rational decisions to protect the trees stands, and therefore the natural landscape and social values of the urban areas.

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