Table of content:

INTRODUCTION

This manual is the result of the Leonardo da Vinci project titled: **Improving Vocational Education in the Construction Industry Sector with the aim of Identification and Recognition Qualifications in European Union Countries 2008-1-PL1-LEO05 -02059**.

Polish Association of Construction Industry Employers – Poland was the promoter of the project.

Partners of the project: Polish British Construction Partnership Sp. z o. o. – Poland, CREDIJ (Centre regional pour le développement la formation et l'insertion des jeunes) – France, University of Minho – Portugal, Ufficio Scolastico Provinciale di Venezia – Italy, Econometrica Ltd. – Greece, The Chartered Institute of Building – United Kingdom.

PROCONSTR is a project concerning developing an innovative program of vocational training based on eight selected construction professions for graduates from vocational schools, technical secondary schools, and employees who are professionally active and want to increase their skills.

The aim of the job modules is to promote the idea of regular vocational development, support activities leading to implementation of European tools concerning education and vocational training – equalisation of opportunities on European labour markets, intensification of cooperation among companies from construction sectors and social organisations in order to promote vocational development with reference to EQF and ECVET in the Europe.

Moreover the project's challenge is to make participants in the training sessions more aware of the requirement to increase their vocational qualifications with regular training sessions, as well as learning new techniques and technologies that are utilised in the construction industry and language education. Once these skills have been gained it will give them the opportunity of being employed across the European Union.

Unification of essential regulations of vocational qualifications in European Countries might simplify easy transfer of the most modern technologies as well as enabling common usage of knowledge and generating new employees that are able to meet the requirements of contemporary European market.

The nature of the training sessions is directed at men and women, with supporting efforts heading for equal opportunities to access to vocational education and to ensure equality on the labour market, in this case, giving special consideration to the construction branch.

The outcome of the project is an innovative didactic resource for beneficiaries. Eight job modules were created on the basis of data collected and domestic markets available. The didactic materials were created with support of construction companies on national levels.

- **Job Module for Bricklayer**
- **Job Module for Carpenter**

- **Job Module for Plumber**
- **Job Module for Electrician**
- **Job Module for Concrete builder**
- **Job Module for Roofer**
- **Job Module for HVAC worker**
- **Job Module for Plasterer**
- **Module for trainer**

Each job module consists of two parts with the first part being theoretical, including the latest know-how concerning specific trades necessary for employees. The second part consists of training with appropriate examples set out in exercises based on chosen innovative aspects.

The project's creators hope that the final product has a long-term influence which can be utilised successfully in vocational education throughout the European Union. The use of a unified course of vocational training in all countries would result in elimination of formal and informal barriers concerning easy-flow of employees and equalize differences in professional qualification levels.

Equalization of qualifications between European countries would result in the effective exchange of experiences; simplify identification of different types of problems (in less developed countries) and the implementation of preventive means.

Conclusions drawn from the executed project could be used to create new training solutions as well as to prepare vocational education system reforms on a domestic level.

More information on project website: www.proconstr.eu.

INFORMATION ABOUT THE COURSE

Participant should have the following prerequisite knowledge concerning carpentry prior to attending this course.

The innovation which participant will learn at the course concerns: constructing modern timber beam formworks used e.g. with fairfaced concrete and self-climbing scaffolds.

The participant will gain knowledge about construction of formworks, new materials and new fields of use for wood on a building site.

After the course one will understand how to read the assembly drawings, what the important aspects are when assembling the formworks, what the newest trends in terms of materials and technologies are when using the timber formworks with modern concrete.

Participant will receive a manual and CD, full of didactic materials like ppt, pdf and vocabulary.

One will be asked to participate in the theoretical lectures (1 day) and practical workshops (2 days) which are conducted by a vocational trainer. Moreover they will gain knowledge on how to read and use additional materials included in this course.

Participants knowledge will be tested/assessed by a trainer with the use of a set of questions at the end of the course.

After completion of course each participant will gain **PROCONSTR CERTIFICATE**.

PREFACE

The PROCONSTR project is intended for two main groups of construction workers; qualified workers and medium-level technical supervisors. Eight trades covered by the project represent the main professions of a large cubature house building sector as well as the infrastructure sector that constructs office buildings, hotels, commercial, cultural and sport centers, healthcare infrastructure and other public utility buildings. Experts in the fields covered by the project are also crucial for the single-family house building sector. They are equally important in the industrial and road construction sector.

Traditional trades like: concrete builder, carpenter, reinforced concrete builder, mason, roofer, and plumber are currently undergoing a dynamic evolution due to the technical progress in the construction field.

The common use of concrete pumps together with concrete mixers and widespread application of chemical products in construction such as self levelling floor compounds and resin are an important part of the prefabricated reinforced-concrete elements which are used for ceiling construction. Common use of prefabricated reinforcement elements such as meshes and cages has been an important influence on the change from the traditional idea of seperate concrete and reinforced concrete builders. Joining the two trades together creates a more universal trade for the reinforced concrete builder.

The widespread application of formworks and scaffolding used on all types of construction sites has a decisive influence on the ongoing changes in the profile of the carpenter's profession. Similarly, an exceptionally wide range of roof coverings and new methods of assembling makes a crucial impact on the modern definition of the profession of a roofer. Important changes are happening in the field of masonry, where masons are required to have an in-depth knowledge of all types of plasters and glues. The knowledge of an electric fitter has to cover a wide range of low current electric installations. A trade which is currently undergoing particularly dynamic changes due to a huge progress in the field of air conditioning techniques is the HVAC fitter.

Equally, significant progress can be seen in the field of sanitary techniques. A whole range of equipment is available on the market that has not been used before. The use of internal or external materials made of epoxy resins, carbon fibres and other synthetic materials has already exceeded the percentage use of traditional materials. The introduction of different types of plaster, dry walls or other wall elements like cardboards, significantly widens the requirements relating to the trade of a plasterer.

Apart from technological changes that have influenced the profile of vocational training, it is impossible not to mention general requirements which have to be fulfilled by modern construction teams.

These requirements include:

- a significant shortening of the project implementation cycle,
- limiting the area of construction sites, particularly in urban agglomerations,
- the expansion of vertical-building projects,
- the introduction of a top-down method, i.e. a simultaneous construction of both the underground and ground structures,

– carrying out the works in extreme weather conditions, due to the possibility of putting concrete layers at both low and high temperatures.

Nonetheless, health and safety at work is the most important issue, relating to both the dynamics of changes in vocational profiles and strict requirements.

The expansion of the European Community favors the free movement of services in the construction sector. This reinforces the creation of construction companies with international capital. It also creates the need for mobile construction teams, which together with the high quality requirements constitutes an incentive for the unification of qualification of construction workers on the highest level in the whole Union. The aforementioned reasons underline the importance of changes undergoing in the field of construction trades.

A good economic situation for the construction market affects economic development substantially. Demand for residential housing, office space and infrastructural building increases. Orders placed by investors motivate contractors to carry out their jobs and the contractors stimulate enterprises manufacturing building materials to maximize their production capacities; it enables quick completion of construction investments. Consequently, a system enabling stimulation of economies and decrease in the unemployment rate is launched.

When a market presents a demand for a quick and thorough carrying out of investments, the most serious problem there is finding a relevant contractor team consisting of high-class specialists knowing all aspects of a profession and that are trained to the latest methods and technologies used within the construction project, in particular, in fields of their specialization.

Chapter I INTRODUCTION TO CARPENTER TRADE

With an axe and a plane…or about the carpentry profession in a traditional sense

"As the master carpenter is the primary organiser and manager of the carpenters, among his responsibilities is understanding domestic legal regulations, learning local laws and regulations as well as observing rules which he, as the master carpenter, had set. A master carpenter having knowledge and experience in measuring and designing various facilities, employs people to construct houses. In that, the master carpenter is like a martial arts master. During the sorting of wood for house construction, straight wood pieces without knags and a pleasant appearance will be designated for front pillars. Wood with knags but straight and strong may be used for back pillars. Weaker wood but without knags and a nice appearance may be used for thresholds, lintels, doors and walls. Pieces that are crooked with knags, but strong, are preventively used after checking its endurance for various elements of the house. A house built as such will be solid and durable.

Even knaggy, uneven and weak wood can be used for scaffolding and later used as wood for heating. The master carpenter manages his apprentices by assigning them to tasks appropriate to their skills. He directs some to making floors, some to doors and walls, and others to making window sills, lintels and ceilings. Unqualified apprentices are assigned to lay out floor joists and those with even less skills – to hew wedges. When a master craftsman divides the tasks to the correct skilled apprentice, the work process runs smoothly. Productivity and undisturbed work, prudence in everything one does, spotting true courage, recognising various levels of morale, brings out trust and awareness of what can be done and what cannot be expected – these are issues going through the mind of the master craftsman. And such are also the principals of martial arts.

In using woodworking terminology, one can say, that warriors hone their tools, create various types of useful tool implements and keep them in their own tool boxes. Instructed by the master carpenter they hew pillars and girders using carpentry axes, shape shelves and floors with a plane or even cut out openwork and relief sculptured ornaments. They check if all measurements are correct and efficiently carry out any necessary works. When someone learns to perform all the skills needed in this craft in practice, then he may finally become a master carpenter. Carpenter's tools must be sharp, and they must make certain that they always are. It is a carpenter's job to use the said tools efficiently with due proficiency even in making small chapels, shelves, tables, lamp stands, cutting boards or dish covers. Being a warrior is also based on the same. This thought should be considered in-depth. Avoiding wood warpage, fitting joists, efficient planning, preventing abrasions and making sure that the wood will not warp with time are indispensible abilities of a carpenter. If you want to learn martial arts, take everything I write to heart and think it out thoroughly."[1] We find such information and

[1] Miyamoto Musashi, Thomas Cleary, Księga pięciu kręgów, translation: Agnieszka Sobolewska, ISBN: 83-7361-954-2, original title: The Book of Five Rings (Shambhala Library), pgs. 31-33

teachings in “The Book of Five Rings” written by one of the greatest warriors in Japan’s history: Miyamato Musashi. Placing an equality sign between a master carpenter and a samurai and such a renowned Ronin is one of the best proofs of the fact that the high rank of this profession over the span of centuries resulted from not only tradition of building but first and foremost from many important skills, which a craftsman with this professional field had to have. Carpenters mastered one of the oldest crafts people learned to use in order to satisfy their basic needs – the need to own shelter. This craft observed in animals was subject to a permanent evolution accompanying the development of mankind. With time, carpenters not only erected houses but also built and renovated sacral, livestock (animal barns and stables), warehouse (barns and granaries), industrial (smithies) as well as communication (bridges and footbridges) structures.

Long ago the abundance of woods caused the popularisation of ‘construction out of wood’ in the entire moderate climate zone. Through millennia complete wooden buildings were erected whilst wooden ceilings, roof trusses and stairs are still being made out of wood to this day. Thus carpentry as a craft played a vital and spectacular role in peoples’ lives and what goes with it, it reached a very high workshop level. In rural areas almost every man knew how to carry out basic carpentry work. However, mastering the profession required lots of training, as besides processing wood one had to learn to apply drawing board geometry and construction calculations in order to properly make a roof truss, bridge construction or scaffolding. Knowledge of construction statics applied in practice by carpenters evoked recognition and admiration as did their planning and carrying out raw material processing ability and efficiency in the use of tools. At first, the said skills were passed on from father to son. After some time a craftsman’s education system was established reminiscent that of today.

The basic carpentry works are based on constructing entire buildings or elements thereof out of wood. These could be buildings, bridges, towers, fencing, bunkers and many other structures by using various wood elements made in structures built from other materials: roof trusses, ceilings, stairs, floors and wood panelling in buildings, sidings, footbridges and safety railing in steel constructed tanks and towers, footbridges and railings in reinforced concrete tanks etc. Moreover, the making of support elements for construction sites is also a part of carpentry, for scaffolding, planking and managing elements of the construction site, which enable the execution of permanent structures.

Regretfully, the dynamic development of monolithic construction in XX century pushed the admired craftsman down to the level of an assistant at a building site and for many decades blocked the development of his profession. The need to support environmental technologies which for the first time were emphasised on the global arena in the documents from the Earth Summit in Rio de Janeiro in 1992 opened an absolutely fresh page for carpenters. A series of criteria were then formulated enabling the differentiation between environmental technologies, bringing to attention that concept should not only encompass the issue of outfitting (equipment) but also a given process construction methods, organisation issues, as well as raw material management including energy. It is accepted that environmental technologies compared with currently applied processes in similar business areas, allow for the manufacture of the same products, offering services or ensuring other consumption needs with lesser impact on the environment on all or either one of its “life cycles”.

The natural consequences of the global fight for "the right to development must be fulfilled so as to equitably meet the developmental and environmental need of present and future generations"[2] became a rational forestry natural resources policy and its impact on using wood in the building industry, thus the work of carpenters who in a relatively short time, must make up the XX century techniques and new developments as well as professional knowledge placed at a standstill and become, once again, as it was centuries ago, efficient and admired master carpenters. Master carpenters who, as "the main organisers and carpentry managers"[3], will not only practice their ages old craft to perfection but will simultaneously be able to master over the greatest challenge of construction in the future decades, which certainly is concrete otherwise known as the "marble of the XXI century".

Limiting emission of CO_2 - a power engine for master carpentry craftsman profession workshop development

In the first chapter the Earth Summit in Rio de Janeiro described the desire of our civilisation environmental technologies, not only as a production process, but also as an instrumentation system, organisation system and raw materials and energy saving systems. Environmental technology in the carpentry craftsmanship postulate was clearly and emphatically included in the opinion of the Economic and Social European Committee on the subject of the role of woods and the sector related with forestry in meeting the EU obligations pertaining to the climate and published in the European Union Official Journal, 22.09.2009, C 228/06.

It defines the usage of timber in construction as follows:

1. The construction sector has a very important role to play in tackling climate change, as 40–50% of the world's primary energy is used in the cooling and heating of buildings (2). It is estimated that almost 40% CO 2 emissions derive from the production of construction materials, construction activity and the use of materials. In 2005, total energy consumption in UE-27 was 1 170,2 Mtoe. The share of industry was 28% compared to 30.9% for transport and 41.1% for domestic use. The cooling and heating of buildings is responsible for 8% of carbon dioxide emissions and a significant proportion of such emissions can be avoided through professional construction and new techniques as well as by increasing the share of wood used in construction.
2. Wood is a low – energy, renewable and carbon neutral building material throughout its entire life – cycle. No other common building material requires as little energy to produce as wood does. Using one cubic meter of wood as substitute for other building materials reduces CO2 emissions in atmosphere by an average of 1.1 tons.

[2] See. http://www.skanska.pl/pl/O-Skanska/Zrownowaony-rozwoj/Zrownowaony-rozwoj-w-Skanska/

[3] Miyamoto Musashi, Thomas Cleary , Księga pięciu kręgów, translation: Agnieszka Sobolewska, ISBN: 83-7361-954-2, original title: The Book of Five Rings (Shambhala Library), pg. 31

3. The use of wood in construction buildings worldwide is limited by the lack of uniform standards, rules and certification criteria. The construction sector should have analysis of life at its disposal – cycles and green-house gas emissions of products, based on scientific calculations, so that it could compare various materials on an impartial basis. Member State governments should incorporate "green construction" timber materials into timber supply policy and apply forest certification requirements that are compatible with the international concept of sustainability development on a more widespread basis."[4]

The above mentioned fragment of the opinion of the Economic and Social European Committee on the subject of the role of woods and the sector related with forestry in meeting the EU obligations pertaining to the climate ensues that in the upcoming years a particular emphasis in the building industry will be placed on the reactivation of erecting typical wooden structures, while on the other hand the emission of CO 2 created during the production of building materials must be significantly reduced. In particular, the second process seems to be unchangingly significant from the point of view that work performed by the future master carpenter craftsman, as high emission of CO 2 during the production of building materials in great measure results from the reinforced steel and concrete production. In the first and second case, decreasing the emission of greenhouse gases can only take place with a limited amount of materials produced, which will only be possible when both of these elements of reinforced concrete obtain increasing growing durability. In other words, the demands for limiting emission of CO 2 by the building industry will not only lead to increased construction of wooden structures but will first and foremost lead to thinning out of the monolithic construction as well as the more precise and automated work related to the forming thereof. These new challenges will significantly change the face of work of the future master carpentry craftsman, who as in the teachings of Miyamoto Musashi will stand to battle not only with timber but also with decreasingly "tolerant to him reinforced concrete". We find confirmation of the above theses already today in the divisions of carpentry specializations, which can be defined as follows:

- wooden construction carpenter – specialising in making, overhauling and conservation of any and all types of wooden houses and roof constructions,
- construction carpenter working in common construction – specialising in the construction of stretcher and support walls in dug out foundations as well as on surfaces and also responsible for erecting temporary wooden structures on building sites,
- concrete and reinforced concrete construction craftsman – specialising in making various types of shoring and scaffolding for concrete and reinforced concrete structures,

[4] Dziennik Urzędowy Unii Europejskiej *[Official Journal of the European Union]*, 22.09.2009, C 228/06.

- chimney cooling systems carpenter craftsman constructing scaffolding and shoring for the building of chimney cooling casing (in heat and power plants to cool water in the cooling of turbo set circulation),
- hydro-technical facilities construction carpenter craftsman – working on the construction of water structure facilities,
- bridge carpenter craftsman – making auxiliary elements (scaffolding and shoring) for steel and reinforced concrete bridge construction as well as wooden bridges.

At present the following are considered to be the primary tasks of a carpenter craftsman:

- analysis of working drawings and determination (basing thereon) the scope of works, required materials and solutions associated with wooden structure,
- evaluation of suitability of wooden elements for the execution of wooden structure,
- preparation of wooden structure elements for assembling,
- organisation of own work station; preparation of materials; structure elements; tools and equipment for the execution of carpenter's works,
- execution of wooden forms and shoring to be used for structures made of concrete and reinforced concrete,
- erection of wooden scaffoldings; working platforms and protective canopies,
- erection of temporary wooden objects at the construction site,
- erection of wooden buildings,
- execution of monolithic and prefabricated building elements made of wood in the buildings made of bricks (e.g. floors/ ceilings; stairs; roof structures; partition walls),
- erection of wooden engineering wooden structures i.e. bridges, towers, hangars; depots,
- transportation of wooden elements at construction site,
- repairs and replacement of damaged or destroyed elements of structures built by carpenters,
- maintenance of wooden structure, its protection against decay and fungi as well against destruction by insects and fire.

Basic Professional skills which a carpenter or carpenter's apprentice should acquire may be encompassed in three thematic blocks:

1. Ability to read with comprehension the information presented in the form of descriptions, manuals, drawings, sketches, diagrams, technical and technological documentation, particularly the following:

- identification of wooden building objects and their structural elements,

– distinguishing between round wood assortments, timber materials; wooden and prefabricated compounds,
– distinguishing between building fasteners and ferrules as well as between the types of structural elements used in carpenter's joints,
– distinguishing between typical small and large scale wooden structures, scaffoldings, prefabricated elements and ready – to – use modern shorings,
– indication of assembling and disassembling principles for wooden structures and carpenter's joints.

2. Processing of numerical and operational data, particularly the following:

– selection of timber materials and prefabricated materials for determined carpenter's works,
– selection of carpenter's tools and auxiliary equipment for the execution of professional tasks,
– selection of machines and other equipment for wood cutting and working as well as prefabricated materials,
– determination of the execution order for carpenter's joints elements and other wooden structural elements on the basis of documentation,
– determination of the execution order for the assembling of wooden building objects and prefabricated objects on the basis of documentation,
– determination of the manner of assembling and dismantling of the shoring of wooden structures,
– calculation of required amount of wooden and prefabricated construction materials,
– calculation of required amount of the compounds protecting the wooden and prefabricated structures on the basis of manuals furnished by the manufacturers,
– estimation of costs of materials and remuneration for work on the basis of cost estimate, bill of quantities or measurement of quantities for works.

3. Safe execution of professional tasks in accordance with valid regulation in the scope of occupational health and safety, fire protection and environment protection, particularly the following:

– indication of hazards for the health and life of the worker employed at the construction site and at any other location where the carpenter's works are performed,
– selection of working clothes and personnel protection equipment (PPE) suitable for the season and kind of work being performed for the execution of carpenter's works,
– indication of the methods of protection of wooden objects against unfavourable influence of rains, snow and wind,
– indication of the methods of first aid for the personnel injured in case of accidents occurred at the construction site.

4. Planning of activities associated with the execution of task:

– preparation of action plan,

– preparation of the list of required raw materials, materials, testing and control equipment and tools ego,

– execution of required calculation, drawings or auxiliary sketches.

5. Organisation of own work station:

– accumulation and arrangement of materials, tools, plants and equipment at the work station in accordance with valid regulation in the scope of occupational health and safety as well as fire protection,

– checking the machines, plants and equipment for technical condition,

– selection of working clothes and personnel protection equipment (PPE).

6. Execution of wooden structural element including typical carpenter's joint in accordance with documentation:

– checking quality of wooden sawn materials used for the execution of the structure,

– making out the shape of carpenter's joints,

– ability to use the carpenter's, joiner's and fitter's tools for manual and mechanical woodworking,

– ability to use measuring tools and templates,

– forming the shapes of joints elements through the woodworking,

– fitting and assembling of the elements of joints and connections of wooden structures being performed,

– checking of quality of the works being performed and elimination of defects;

– keeping the work station clean and tidy,

– setting the work station in order, cleaning of tools and equipment, materials, waste settlement and management.

Chapter II LEGAL BASIS

In Poland

September 7, 1991 (OJ *[Official Journal]* of 1991, no. 95, pt. 45 w/later amendments) and the Craftsmanship Act of March 22, 1989 (OJ of 2002, no. 112, pt. 979 w/later amendments.).

Proofs of carpentry qualifications are:

- a diploma or certificate of competed college or trade school with a carpenter or wood technologist profile,
- master craftsman diploma,
- apprentice certificate or a title of a qualified carpentry worker,
- certificate confirming the knowledge of selected profession skills in the carpentry profession.

Carpentry education takes place at the following types of schools:

- a 3-year basic trade school for high school graduates,
- a 1-year post lyceum school for graduates of: a general studies high school, a subject profile 3-year high school, a 4-year technical high school, a 2-year supplementary education high school, a 3-year supplementary education technical school.

A carpenter may continue his education in a 3-year supplementary education technical school and after obtaining a diploma certifying his qualifications in the field of wood technologist he may continue with his education in a wood technology college. School education completed with obtaining a diploma certifying certain general studies level of education and preparation to perform one's learned profession constitutes a basis for further supplementing and honing of a person's occupational profession qualifications.

Employed individuals obtain knowledge and skills during their entire period of work activity in their profession, while abilities acquired during the work process or through participation in organised training sessions may be confirmed by formal documents certifying the skills in one's profession. This is both beneficial for the employee's best interests – as it facilitates future employment or a job change – as well as for the employer who can appropriately evaluate the factual usefulness of the employee within the context of the human resources' needs of his company. The apprentice and master Chamber of Commerce and Trade examination system is legally binding in Poland and known in the European Union member countries, which is not without significance in the context of creating a uniform job market as well as money earning emigration processes. The characteristic attributes of the Chamber of Commerce and Trade exams is their openness and accessibility for various candidate groups that is for young graduates learning their job working as a craftsman as well as for adults seeking the

possibility of confirming qualifications obtained through professional occupation and being prepared theoretically.

The legal basis for the apprentice and master craftsman examination conducted by examination committees appointed by Chambers of Commerce and Trade is the Craftsmanship Act of March 22, 1989 (OJ, No. 112, pt. 979 of 2002 – uniform text – as well as OJ, No. 137, pts. 137, pt. 1304 of 2003) based on the delegation contained therein, directive of the Minister of National Education of October 12, 2005 on apprentice and master craftsman in profession title examination conducted by examination committees of the Chambers of Commerce and Trade (OJ, No. 215, pt. 1820). The aforesaid document defines detailed conditions and method for appointing the committees and carrying out examinations as well as conditions for allowing taking the apprentice and master craftsman examinations.

The Apprentice Certificate is the primary document confirming professional qualifications within the craft. The certificate authorises the individual to work (perform works) as a qualified employee and hold job positions requiring this qualification. After working for a period of three years allows them to apply for the master craftsman examination.

The Master Craftsman is a document confirming the highest craftsmanship qualification in the profession and facilitates the diploma holder to individually run his own business as well as to hold management job positions within a company. It is also a document which authorises the holder to train young employees (together with a completion of a Teaching Course Certificate).

After Poland's accession to the European Union an increasing amount of people intend to perform their profession in Member States, simultaneously using documents confirming their qualifications. Pursuant to international law, a document which will be legally accepted abroad must be legalised, that is, it must obtain specific authorisation. Treaty on the EU introduced among others as general principles of freedom of the flow of workers and provision of services as well as the right to undertake a business operation in all Member States of the EU. However, obstacles in the application of the above may result in legal limitations introduced by individual states and pertaining to certain professions and occupations, which means that an EU citizen who wishes to undertake a specific profession in another Member State must adapt and observe there practiced principles pertaining to the said occupational profession. For those who have documents confirming their professional occupation qualifications issued by chambers of commerce and trade, it is very important that the individuals' certificates and master diplomas meet all the formal requirements.

The Polish Craftsmanship Guild is authorised to legalise master craftsman and apprentice certificates issued by chambers of commerce and trade, the holders of which intend to use abroad.

Basic legal regulations in Poland:

Education System Act of September 7, 1991 (OJ of 1991, no. 95, pt. 425 w/later amendments).

Craftsmanship Act of March 22, 1989 (that is OJ of 2002, no. 112, pt. 979 w/later amendments).

Building Law Act of July 7, 1994 (that is, OJ of 2006, no. 156, pt. 1188 w/later amendments).

Enactment of the Ministry of National Education of September 7, 2004 on the terms and methods of evaluating, classifying and promoting students, free listeners and carrying out tests and exams in public schools (OJ, no. 199, pt. 2046 w/later amendments).

Enactment of the Minister of Infrastructure of June 23, 2003 on health and safety protection information as well as the health and safety protection plan (OJ of 2003, no, 120, pt. 1126 w/later amendments).

Enactment of the Minister of Economy of September 20, 2001 on occupation safety and hygiene during the operation of machinery and other technical equipment used for ground, construction and road works (OJ, No. 118, pt. 1263 w/later amendments).

Enactment of the Minister of National Education of June 26, 2007 on the classification of job professions in trade and vocation education (OJ, No. 124, pt. 860 w/later amendments).

Enactment of the Minister of Labor and Economy of December 8, 2004 on classification of job professions and specialisations for the needs of the job market as well as the scope of the application thereof (OJ, No. 265, pt. 2644 w/later amendments).

In Greece

Under Greek legislation all construction workers' professional activities are considered hazardous. Thus, the profession of the carpenter is also considered hazardous.

The major dangers are as follows:

- Falls from height,
- Dropped tools or materials,
- Incorrect use of equipment,
- Fire,
- Explosions,
- Scalds.

The legal framework for the carpenter profession covers the following sections:

1. Rules of preparing and undertaking the job.
2. Health and safety regulations.

Works at heights are covered by:

1. Works at height without scaffolds P.D. 778/80 art. 17.
2. Works on scaffolds P.D.. 778/80 art. 9, 11.
3. Works on roofs P.D. 778/80 art. 18, 19.

The health and safety regulations can be categorized as following:

- General regulations for health and safety,
- Working at height using scaffolding and mobile platforms,
- Protection from electrical shock,
- Environment protection.

Legislation referred to health and safety regulations:

P.D. 22/12/33 (I.G.G 406 A΄) "On security of workers using ladders".

P.D. 778/80 (I.G.G 193 A΄) "On security measures during building construction".

P.D.1073/81 (I.G.G. 260 A΄) "On security measures whilst performing tasks related to housebuilding and engineering works".

L. 1396 (I.G.S 126 A΄) "Obligations of observance of security measures in structures".

L. 1430/84 (I.G.G. 49 A΄) "Ratification of the 62 International Employment contract, "As regards the safety provisions in the construction industry and resolving directly related issues".

L. 1568/85 (I.G.G. 177 A΄) "Health and safety of workers".

P.D.71/88 (I.G.G. 32 A΄) "Regulation for fire protection of buildings".

M.O. 9087 1004/96 (I.G.G 849 B΄) "Operational protection of outside workers exposed to the risk of ionizing radiation during their activities in controlled areas".

P.D.395/94 (I.G.G 220 A΄) "Minimum safety and health requirements for the use of work equipment by workers at work in compliance with directive 89/655 EU".

P.D. 396/94 (I.G.G 220 A΄) "Minimum safety and health requirements for the use by workers of personal protective equipment at work in compliance with the directive of the Council 89/656/EU".

P.D. 105/95 (I.G.G 67 A΄) "Minimum requirements for safety and health at work in compliance with directive 92/58/EU".

P.D.16/96 (I.G.G 10 A΄) "Minimum safety and health in the workplace in compliance with directive 89/654/EU".

P.D. 17/96 (I.G.G 11 A΄) "Measures to improve safety and health of workers at work in compliance with the instructions 89/391/EU and 91/383/EU".

P.D. 305/96 (I.G.G 212 A΄) "Minimum safety and health requirements at temporary or mobile construction sites in compliance with directive 92/57/EU".

P.D.. 62/98 (I.G.G 67 A΄) "Measures for the protection of young people at work, in compliance with directive 94/33/EK".

M.O. 7568 F. 700. 1/96 (I.G.S 155 B΄) "Fire protection measures for hot works".

M.O. 130646/84 (I.G.G 154 B΄) "Security measures calendar".

Glossary:

L.: Law

P.D.: Presidential Decree

I.G.G.: Issue of Government's Gazette

M.O.: Ministry ordinance

In Italy

In Italy to become a mason, a carpenter or a plasterer one can attend specific training courses that lead to a qualification after compulsory education & training is completed (16 years old). The courses are organized by construction schools, which allow appropriate competencies and skills to enter the labour market.

The vocational training in the construction sector is managed by a national equal education system regulated by the Collective Labour Agreement (art. 90) for construction companies who are members of ANCE – the National Association Construction Builders and varuiys trade unions (FENEAL-UIL, FILCA-CISL, FILLEA-CGIL).

FORMEDIL is the national body for training construction workers and it promotes, manages, and coordinates training and refresher courses in the construction sector. These are organized by the construction schools located across the different Regions and Provinces.

An individual can choose to take up an apprenticeship in a company (which is different according to each profession) and then be hired. Alternatively, an individual can decide to establish his/her own company. According to the Act 443/85 regarding Crafts, if a person wants to establish a company, then he/she must comply with the information and requirements as set out in the act. In particular, the construction company can have a maximum of 10 employees and 5 apprentices. The number can be increased to 14 employees, but these additional workers must be apprentices.

The application should be submitted to the Provincial Register by the local Chamber of Commerce.

Important links:

- FORMEDIL: www.formedil.it,
- ANCE – Associazione Nazionale Costruttori Edili: www.ance.it,
- CEFME – Formazione, ricerca e servizi per l'industria delle costruzioni: www.cefme.it,
- Chamber of Commerce: www.camcom.gov.it.

To find information regarding the legislation in the construction sector, you can visit the following websites:

- Ministry of Infrastructures and Transports: http://www.mit.gov.it/mit/site.php,
- www.edilizia.com,
- www.edilpro.it,

- www.edilportale.com,
- www.edilbox.it.

Legislation on safety at work in the construction sector

The main legislation relating to safety at work is listed below. Several Regions have also issued regional acts.

- Decree President of the Republic No. 547 – 27/04/1955 "Legislation to prevent industrial accidents".
- Decree President of the Republic No. 164 – 07/01/1956 "Legislation to prevent industrial accidents in the construction sector".
- Decree President of the Republic No. 303 – 19/03/1956 "Hygiene at work"
- Legislative Decree No. 494 – 14/08/1996 "Implementation of Directive 92/58/CEE concerning minimum safety and health standards to be applied in the construction sites".
- Legislative Decree No. 277 – 15/08/1991 "Implementation of several EU Directives concerning protection of workers against the risks associated with exposure to chemical and physical agents".
- Legislative Decree No. 493 – 14/08/1996 "Implementation of Directive 92/58/CEE concerning the minimum standards for safety signs at work".
- Ministerial Decree 10/03/1998 "Safety criteria for fire prevention and emergencies at work".
- Legislative Decree No. 235 – 08/07/2003 "Implementation of Directive 2001/45/CE concerning minimum safety and health standards when using equipment at work".
- ISPESL guidelines to identify and use protection devices to prevent falls.

Links:

- Ministry of Labour: www.lavoro.gov.it,
- Ministry of Infrastructures and Transports: http://www.mit.gov.it/mit/site.php,
- ISPESL: www.ispesl.it.

In the United Kingdom

Generally, the laws governing health and safety relate to all construction activities and trades (including design) and are not industry specific. There are several Acts and Regulations.

Some of the principal Acts which deal with health, safety and welfare in construction are as follows:

- Health and Safety at Work etc. Act 1974,
- Mines and Quarries Act 1954,

- Factories Act 1961,
- Offices, Shops and Railways Premises Act 1963,
- Employers Liability Acts – various,
- Control of Pollution Act 1989,
- Highway Act 1980,
- New Roads and Streetworks Act 1991,
- Corporate Manslaughter and Corporate Homiside Act 2007.

The fundamental Act governing health and safety in construction is the Health and safety at Work etc. Act 1974. The principal regulations of this Act which affect design and construction, are:

- Management of Health and Safety at Work Regulations 1999 amended 2006,
- Construction (Design and Management) Regulations 2007 (known as the CDM Regulations),
- The Work at Height Regulations 2005 amended 2007,

Some other related regulations and guides are:

- Site Waste Management Plans Regulations 2008,
- Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 1995,
- The Control of Major Accident Hazards Regulations 1999 (COMAH) amended 2005,
- The Chemicals (Hazard Information and Packaging for Supply) Regulations 2003 (CHIP 3),
- The Health and Safety (Display Screen Equipment) Regulations 1992,
- COSHH (Control of Substances Hazardous to Health) Regulations 2002: Provision and Use of Work Equipment Regulations (PUWER 98),
- Lifting Operations and Lifting Equipment Regulations (LOLER 98),
- Personal Protective Equipment at Work Regulations 1992,
- Signposts to the Health and Safety (Safety, Signs and Signals) Regulations 1996,
- Control of Asbestos Regulations 2006.

Some of the principal Acts and Regulations which deal with environment, are as follows:

- The Environmental Protection Act 1990,
- Environment Act 1995,
- The Clean Air Act 1993,

- Radioactive Substances Act 1993,
- The Control of Asbestos Regulations 2006,
- The Ionising Radiation Regulation 1999,
- The Control of Lead at Work Regulations 2002.

The regulatory organisations are (according to the Environment Act 1995):

- The Environment Agency (in England and Wales),
- The Scottish Environmental Protection Agency (in Scotland).

In Portugal

Labour Law: The Labour Code in Portugal is regulated by Law n. 7/2009 of 12th February. Further information regarding construction works contracts may be found in the Collective Work Contracts in the Construction Sector (CCT, Contratos Colectivos de Trabalho para o Sector da Construção) published by the Ministry for Labour and Social Solidarity in the Employment and Work Bulletin (Boletim do Trabalho e Emprego) n. 12 of 29th March 2009.

Standards for the Small and Middle-size Enterprises (SME): There are no specific regulations for SME. For the construction and real-estate companies there is a regulating entity (the Construction and Real Estate Institute -in PT, Instituto da Construção e do Imobiliário, INCI) and specific regulations concerning the admission and practice activity, namely:

- Decree-law n. 12/2004 of 9th January 2004 establishes the legal framework for the admission to and permanency in the construction activity,
- Decree n. 19/2004 of 10th January 2004 establishes the categories and subcategories related to the construction activity,
- Decree n. 21/2010 of 11th January 2010 establishes the value of the construction works according to the qualification categories of the building permit for 2010,
- Decree-law n. 211/2004 of 20th August 2004 regulates the real estate activity.

Basics of construction standards: General Regulations of Urban Buildings (in PT: Regulamento Geral de Edificações Urbanas, RGEU) approved by Decree-law n. 38382 of 7th August 1951 (altered by Decree n. 38888 of 29th August 1952 and further revisions). A new version is foreseen to be published soon (in PT: RGE).

Basics of construction Works Contract: For general contracts, the Civil Code approved by Decree-law n. 47344/66 of 25th November 1966 (1st version) and for public contracts, the New National Public Procurement Code approved by Decree-Law nº 18/2008 of 29th January 2008 (modified by Decree-law n. 278/2009 of 2nd October and Decree-law n. 223/2009 of 11th September).

Health, Safety and Welfare Regulations: Decree 41821 of 11th August 1958 establishes the work safety regulation for building construction; Decree-law 441/91 of 14th November 1991 establishes the general principles for the promotion of Health, Hygiene & Safety at work (transposes Directive n.º 89/391/CEE of 12th June); Decree-law 273/2003 of 29th October revises the legal framework on Health and Safety conditions in the construction site (incorporating the minimum prescriptions required for temporary/mobile construction sites established by the Directive n.º 92/57/CEE of 24 June).

In France

1- Basic concepts: standards, DTU, Technical advice (Avis Techniques).

1.1. Standards: see: Standards and European directives (source: AFNOR)

French approved standards are mandatory for State and local government funded contracts. They are also recommended for privately funded contracts.

1.2. **DTUs** (Unified Technical Documents) are documents that contain technical rules relating to the execution of building works using traditional techniques. They are recognized and approved by construction professionals. They also provide a reference point for insurance experts and the courts. Failure to comply with DTUs may lead to the invalidation of warranties offered by insurance providers. DTUs specify standards for traditional construction methods and are considered the epitome of reference texts. They are intended for relevant state bodies as well as contractors (whether architects or general contractors), owners and other experts. They are authored by a committee advising on technical texts.

1.3. **Technical advice** is advice from a committee of experts specialising in relevant trades and the expected behaviours of materials, components or processes. They define the characteristics of any materials, components or processes involved, and give advice on their durability and suitability for use and how they comply with regulations.

2 - DTU

2.1. Status of DTU

The DTUs are established by a body created in 1958, the "**Groupe de Coordination des Textes Techniques** / **Groupe DTU"** (the "Coordinating Group of Technical Texts or Group DTU").

In 1990, this group became the "**Commission Générale de Normalisation du Bâtiment/DTU** "(the General Committee for the Standardisation of Building / DTU) in order to integrate it into the French official system, which was necessary to comply with European technical harmonization (Eurocodes)

This means that the DTUs have become standards. The transformation took place gradually through the regulatory procedures that govern standardsation.

As a result, the DTU(s) now have one of the following statuses:

Approved French standard (**Norme française homologuée):** this is a standard which has received official government approval, its technical value is recognized, and it plays an important role in the construction system,

Experimental standard (Norme expérimentale): which is undergoes a period of probation before being confirmed or amended to become a certified French standard,

Documentation booklet (Fascicule de documentation) : standard documents, essentially informative documents,

DTU: the original form of the documents. Not part of the official standard system. In most cases DTU status is temporarily held in anticipation of its integration into the official standard system.

2.2. Private works

DTU is implemented following an agreement between the "maitre d'ouvrage" and the construction contractor. A DTU only commits the signatories, giving it a sense of obligation of contract.

Some standards and some French registered DTUs can be mandatorily enforced by regulatory decisions (often when safety-related).

2.3. Public works

The amended Decree of January 26, 1984 governs the application of French standards in contracts approved by the government, local authorities, public bodies etc., except in special cases as listed in the decree.

2.4. Composition of a DTU

A DTU may consist of the following documents:

Technical specification clauses booklet (**cahier des clauses techniques**: **CCT**) which sets out the requirements for the selection and use of materials,

Specification of special provisions booklet (**cahier des clauses spéciales**: **CCS**) which defines performance limits and obligations to other trades,

Rules for calculating the structural design.

All these documents are contractual documents and must be adhered to. There are also other documents, such as memos and selection guides, which are useful for structural designs that are not intended to be imposed by contract.

Like ISO standards, the DTU(s) must be bought. They can be found on the CSTB website: http://boutique.cstb.fr/

(CSTB = centre scientifique et technique du bâtiment: scientific and technical center for construction)

DTUs and other required documents are listed on the CSTB website. There are specific DTUs for each profession : (see example for roofers on the next page)

http://boutique.cstb.fr/dyn/cstb/Upload/Fichiers/Liste_0310.pdf

HEALTH AND SAFETY

On building sites required by the coordinator of safety to have a general plan of coordination, the companies involved must create a **PPSPS** (Particular plan of safety and protection of health) valid for **all workers** on the building-site

PPSPS: Particular plan of safety and protection of health

Contents of the PPSPS

1. The name and address of the company, the address of the building site, the name and qualifications of the person in charge of the work.
2. The description of work and methods of work showing the company's specific risks and chosen means of prevention, taking into account any environmental constraints. Work involving risks of interference arising from co-activity with other companies, mutual risks and the prevention methods available.
3. Procedures for observing any measures of general coordination defined by the coordinator.
4. Rules for hygiene and for workers' areas as laid out in the general coordination plan .
5. First aid organization of the company; including the medical equipment available, first-aiders and on site, measures for evacuating any injured persons, according to the general coordination plan.

The descriptive part of the plan is the most important; it must be accompanied by a detailed analysis of the risks related to procedures, materials, devices and installations, the use of dangerous substances or preparations, and to circulation on site.

Plans or sketches drawn for the building site can effectively replace text. Photocopies of documents are to be avoided in general , except for private copies.

The plan can evolve and change, so it is always possible to modify any of the given procedures or preventive measures if the incurred risks are decreased or if the preventive measures give an equivalent guarantee.

Texts referring to the **labor regulation:**

Principle of prevention articles R 230-1 with R 234-23,

General plan of coordination R 238-20 to R 238-36.

texts **for the prevention and the safety of the worker**s:

N° circular 6 DRT of April 18th, 2002 of the ministry for employment and solidarity,

Law N° 91-1414 of December 31st, 1991 published with the OJ N°5 of January 7th, 1992,

European directive 89/391/CEE of June 12th, 1989,

Decree 2001-1016 of November 5th, 2001 relating to the single document published in the 258 Olympics of the 11/7/01 page 17523.

Chapter III A NEW CONTEXT

With system shoring and self-inversion system…or about the carpenter craftsman job in the XXI century.

"Higher, quicker, farther" is not a slogan taken out of a sports event commentary but a normal day at a construction site. These significant words should be supplemented with the word "safer" in order to fully present the atmosphere of erecting structures in the XXI century. Today's construction sites are complicated undertakings upon which taken from the teachings of Miymato Musashi about "productivity and work without disturbances, caution in everything, noting true courage, recognising various levels of morale, building of trust and being aware of what can and cannot be expected, again seem to be the fundamental issues being the forethought of the master carpenter craftsman". Today's master carpenter must not only recognise the quality of wood but take care to make sure that his tools are sharp and at the same time see technical and technological possibilities of shoring systems used by him and his apprentices. Their history is the history of concrete reaching as far back as times before the Roman Empire.

Concrete is already used for construction in Assyria, and in ancient Rome, although was completely forgotten in the middle Ages. In ancient times, a mix of sand and tiny stones with lime mortar was used to join stones in walls or ceilings addition of volcanic ash made the Roman concrete waterproof. In areas far from volcanos, finely ground roof tiles were used, and in some places bird faeces are used as a binding agent. During the Gothic age a mix of lime mortar with very fine sand was used to create repetitive decorative elements.

As of the XIX century – after the invention of Portland cement – concrete quickly became popular in Europe. Its attributes were especially acknowledged during the first half of the XX century in Germany where it was commonly used in building highways and monumental structures. This constituted the beginning of a dynamic growth of monolithic construction out of concrete and its culmination during that time was the construction of the largest reinforced concrete ceiling of the pre-war world which was, and is to this day, the roofing of the Hala Ludowa in Wrocław, Poland.

The concrete boom was disrupted in the 60's of the past century and replaced with steel construction. The tragedy of September 11, 2001, when terrorists attacked the World Trade Center towers in New York, which was made of steel, collapsed quickly burying thousands of victims, once again, reminded the world of the attributes of reinforced concrete built structures.

Today we see the triumphant return of concrete construction in industrial building / chimneys, excavation shaft, television towers, bridge construction and residential / public construction. Concrete became the desired material in the hands of architects and artists. There are a growing number of structures of unique block designs that would be impossible to achieve without the use of traditional building methods.

A huge attribute of monolithic construction is the necessity to observe technological discipline in full as well as forcing proper work ethics by worker brigades. By

technological discipline one is to understand the precision of forming element assembly, maintaining its set technical efficiency, consistent application of set methods in preventing concrete adhesion to the sheathing forming panels, care for the cleanliness of its surface. All of this must go hand in hand with the proper placement of reinforcement, ensuring it with the appropriate layer of insulation and placement of installation cables and equipment. The said technological discipline encompasses also the propriety of preparation, transportation, stacking, thickening of concrete mixture, caring for hardening concrete, timeliness as well as diligent disassembly of built structure technologies as a whole.

At the time, and during production, the stacking process at the construction site, requires care to be taken with the application of the shoring systems for slabs, hoists, support beams and equipping of the scaffolding systems transport and conservation. Monolithic construction is subject to ongoing technical and technological evolution, and this requires properly prepared staff at each construction stage. Increasingly better shoring systems enable to cut down first and foremost the execution time of the structures which directly translates into concrete money but it also allows to save on recruitment simultaneously ensuring greater safety of the working teams.

New work environment of the carpenters in the monolithic building sector forces them to expand their hitherto palette of occupation skills and proficiency palette by the following actions:

1. Ability to read with comprehension, the information presented in the form of descriptions, manuals, drawings, sketches, diagrams, technical and technological documentation, particularly the following:

- analysis of drawings and establishing on the basis of the scope of works and materials needed as well as carpentry, shoring or scaffolding construction solutions,
- knowledge about the basic shoring and scaffolding systems used in construction and evaluating their usability in carrying out shoring or scaffolding construction,
- knowledge of principles in making work and technical drawings,
- basic knowledge of building law,
- observing work organisation principles at work station on the construction site during individual as well as team work.

2. Processing of numerical and operational data, particularly the following:

- adapting shoring and scaffolding systems to the recommendations of the manufacturers in the scope of quality and safety of their application,
- assembling shoring shields and scaffolding from prepared system elements according to set order and assembly project,
- using measuring tools and quality control over assembly works especially the quality of joists, connection and the vertical and horizontals of the assembled shoring and scaffolding element systems.

3. Safe execution of professional tasks in accordance with valid regulation in the scope of occupational health and safety, fire protection and environment protection, particularly the following:

– safely transport shoring elements and scaffolding on the construction site,
– using auxiliary tools and equipment and especially electric tools according to their designated use,
– maintaining cleanliness and order at work station, cleaning of work station, cleaning of tools and equipment, settlement of material and managing of waste,
– using fire-fighting equipment,
– observing recommendations of Occupation Safety and Hygiene and fire prevention.

Concrete, in good hands, is a rewarding building material. Not only can the highest residential in the world Burj Dubai be built out of it, but also the Center of Science in Wolfsburg, the longest viaduct in Central Europe in Kóróshegy or an unusually shaped sports stadium – Allianz Arena in the north of Munich, Germany.

Each of the above structures can compete for the title of the greatest structure of the XXI century while the creators of these great works of material culture, permanently write themselves into the history of our planet. Among them were for thousands of years and will continue to be for the next millennia, people called the master carpenter craftsmen – the samurai of the mind, ability and perfection in the usage of tools.

Chapter IV DESCRIPTION OF NEW SOLUTION

The information given here are supplemented by the multimedia presentation and should be performed simultaneously.

The process of choosing the right formwork for the task is very complex. There are numerous conditions the contractor has to consider by choosing specific formwork.

Here are some of the criteria one need to settle with the building company:

- desired result (e.g. fair-faced concrete, allowed imperfections),
- technology restrictions (e.g. geometry, is there enough space for the assembly on the site),
- concrete pressure (e.g. what kind of concrete will they use, how fast do they want to pour),
- project's time schedule (e.g. length of a cycle, length of the whole site),
- delivery possibilities,
- prices.

If all the boundary conditions are known, the contractor company chooses the right system and the planning phase starts.

The end result is the delivery documentation that goes to the client and assembly and production drawing if required.

Types of formworks

There are two formwork technologies for the wall applications: panel and timber formworks.

The panel formworks are basically steel or aluminium frames with plywood or steel plate as a face of the panel. The formwork comes in different sizes which makes it easier for workers to fit to the desired building construction. It is perfect for straight walls that have to be plastered. This kind is commonly used on smaller sites because they do not need planning and user can choose formwork parts for themselves.

Timber formworks on the other hand are used on big sites (high buildings, dams, bridges) where panel formworks cannot be used due to the complexity of the building or because of the economic factor. Timber formworks are relatively cheaper when it comes to large numbers of reuses, especially when you are thinking about the concrete cores of high buildings. If you look at the walls of Phaeno Science Center in Wolfsburg you will realise, that it is sometimes better to build timber formwork for such a building, than a custom steel one. Wood is easier to work with and cheaper to buy. Also the production process needs less effort and less money.

Traditional and most commonly used slab formwork is put together with the use of plywood, timber beams and steel floor props. A carpenter's job in this case is to cut the plywood to all the fitting zones of the slab before the reinforcement will be put in place.

Materials

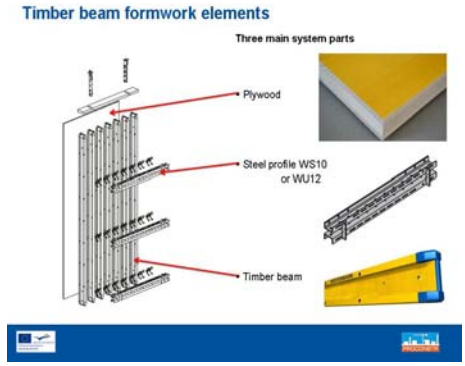
Standard timber beam formwork consists of four main categories of elements:

Plywood – depending on the Customer needs and desired effects (concrete surface): 3-layer and 5-layer is a standard solution, structured will leave an imprint, multilayer is the cheap solution, plastic gives an extra flat surface, composite join some of the above characteristics.

Timber beams – different lengths for different applications and needs. The bigger the section, the stronger the beam is, but also heavier and more expensive. Most popular is the H20 beam (the height of the section is 20cm).

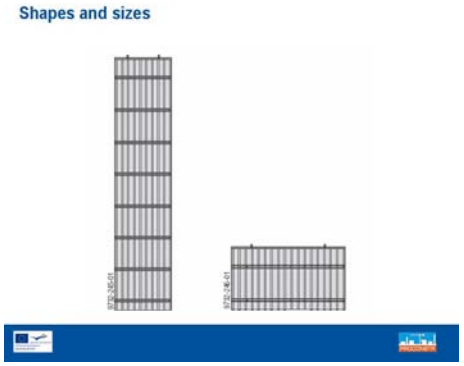
Steel profiles – galvanized or powder coated is used for carrying concrete pressure to the tie-rods. Steel is used due to its strength and low cost. The coating prevents rusting.

Accessories – used to connect the parts together.



Although timber formworks were used previously, this joined technology of steel and timber was first used in 1965.

It is possible to make timber forms in any size, but because of the practical reasons the biggest height (=length of the beams) is ca.12m and the width (=length of the steel profiles) is ca. 6.0m. That is 72 m^2 of formwork in one panel. The biggest elements of panel formworks are 9.0 m^2 and a lot heavier.



Spacing of beams and profiles depends on design requirements like concrete pressure and formwork imprint etc. The higher pressure, the denser the construction gets.

You can achieve different shapes using shaping wood, not only on straight walls, but also corners with any angle, curved walls or even spherical shapes.

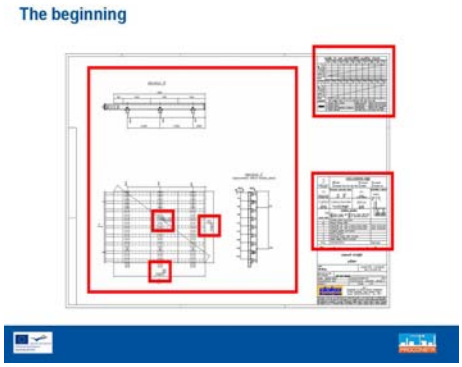
Preparation for the assembly

Preparation for the assembly will involve finding a suitable place, gathering needed tools (electrical saw, jigsaw, hammer, drilling machine etc.) and material. Most of the single elements will be carried by hand, so place them close to the assembly area. You will probably also need a device to move the assembled formwork element (e.g. forklift, gantry).

Engineer/designer who was designing the solution should provide an assembly drawing before preparation for the assembly of a formwork panel. The drawing consists of the main area with all the views of the panel, measurements and the material list with all the additional information required.

Some of the measurements are made from a base point not between the elements. This makes the assembly process easier (there is less room for measuring mistakes).

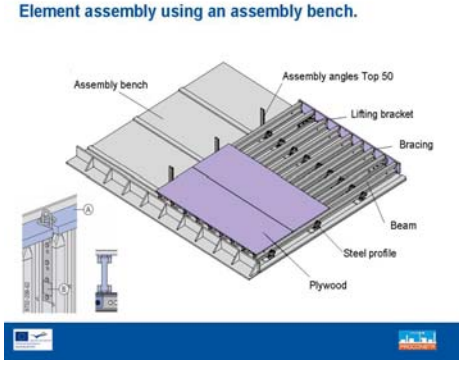
All the details of assembly, alternative solutions and safety remarks are always given in User Information or other instructional brochures. It is recommended to read the instructions and study drawings before the assembly.



The last, but also a very important topic is the quality control. If the element has to be rectangular you will have to check at least 3 figures: Width and length of the element to see if it matches the design and both diagonal lengths. If they are not the same, the element is not rectangular and can cause troubles when being used on the site e.g. will leave a gap impossible to fill between the two neighbouring elements.

Steel profiles placing

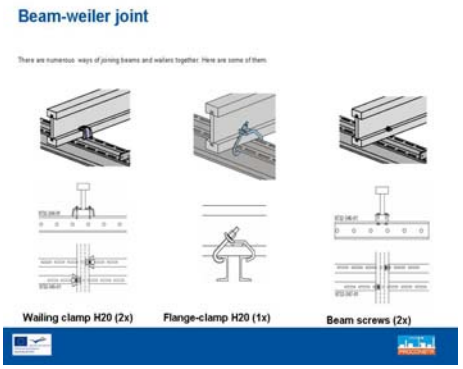
Each element will be built on a special assembly bench which must be prepared earlier. The bench enables you to do few elements in a row much faster and more accurately. The important thing is to line up all the steel profiles on the same height, in various panels. When on the building site, these profiles will be joined together with connecting plates to get a ridged formwork. If the profiles are in the wrong place the workers on the site will not be able to connect them together and the formwork itself will be useless.

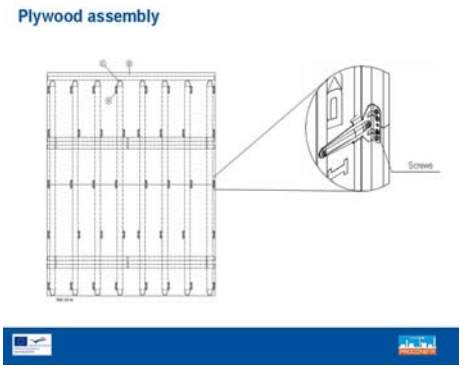


Connection methods for individual component elements

Timber beams and steel profile are connected with special screws or clamps.

The plywood is screwed onto the beams. It can be done from the face or from the back of the ply (with the use of special profiles). You cannot use nails, because the element will be damaged while being rearranged on the site. The plywood sticks to the concrete strong enough to strip the ply from the panel together with nails. And it is easier to exchange the used ply sheet for a new one when you unscrew it from the panel.

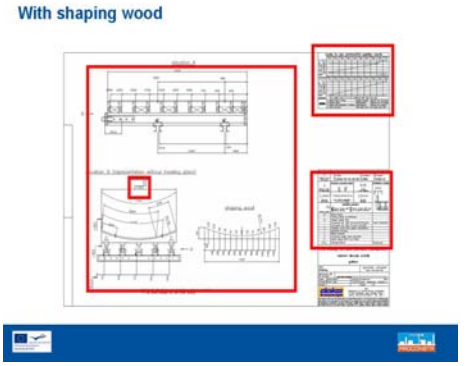




In case of other surface shapes (e.g. round columns) additionally you mount special shaping woods (wood arch) between ply sheets and timber beams or between the beams and steel profiles.

The shaping woods (wood arches) should also be featured on the assembly drawing. If the shape is complicated or there are few different shaping woods on one panel they will be drawn on separate drawings.

After the assembly the assembly area should be cleaned (sweep the floors, leave the tools in order, cleaned and unplugged).



New technologies

Even here there are some new technologies being introduced. There are new composite plywood sheets available, plastic plies or composite timber beams, but the principles stay the same.

Also new materials and technologies were put into the construction process itself. Construction companies started using climbing formworks, and later on the self-climbing systems.

New types of concrete are introduced like the SCC (**Self Compacting Concrete**). The concrete is much more fluid than normal mixtures, but it is not just the case of adding more water to the normal concrete, it involves some special additives so it does not need vibrating to get the air out of the mixture. In that case there is less work and the end effect is cleaner and much more predictable. The concrete itself is often brought into the formwork through a special valve placed in the bottom part of the element.

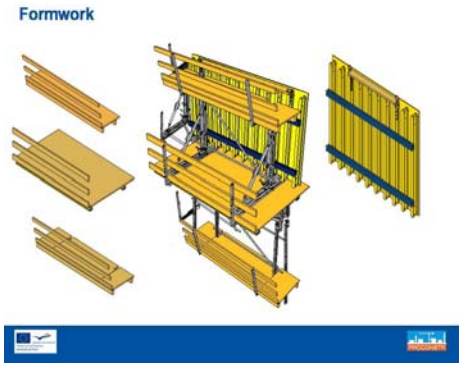
More and more often there can be observed on site the so called **stripping corner**. It is an element that allows the inside formwork of the elevator shaft to be set back without the need of total disassembly. It is later moved by a crane as a complete unit (site crew does not have to take the formwork apart between the cycles) so it saves time and labour.

As people started building higher structures, the new building methods were developed. To save the time while moving the formwork, in 1971 the engineers developed platforms to carry the formwork and at the same time to have a safe place to work on. Those kind of formworks are a kind of working scaffold. They are hung on the already existing part of the building and moved by crane. Later as the labour costs rose it was important to save the crane time so the hydraulic systems were incorporated into the working platforms.

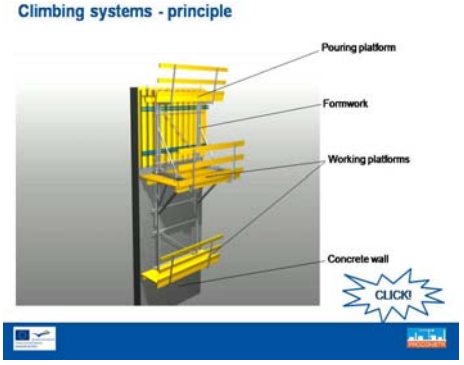
Of course as systems get more complex and automated their prizes rise. But at the same time they are also a lot quicker to move to the next casting step so they save money. It is something to consider whilst looking for the right system for the job.

A climbing formwork

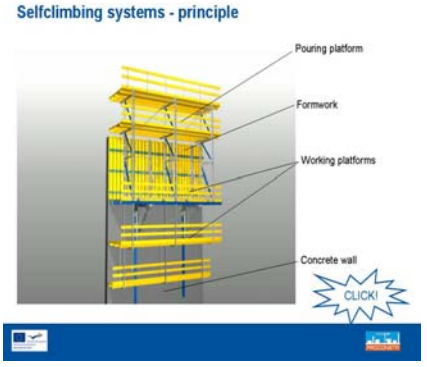
A climbing unit consists of few main parts, the formwork itself, steel construction of the unit (profiles, hanging shoes, and consoles), and planks and beams as a work surface for the concreting crew. In basic systems (like Doka's K) the formwork on the platform can only be tilted back. With all the other systems the formwork is usually retracted.



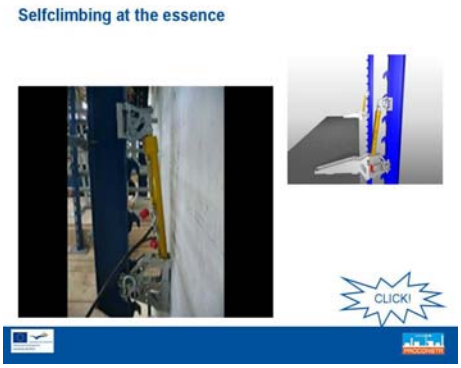
The principle of working with the **climbing system** is simple. After the concrete has set, the formwork has to be moved back from the wall, and then a crane lifts the unit to the next anchoring point. The anchors of the next casting step are nailed onto the plywood and will stay in the wall when the concrete sets. The wall is reinforced, concrete is poured and then the process repeats itself.



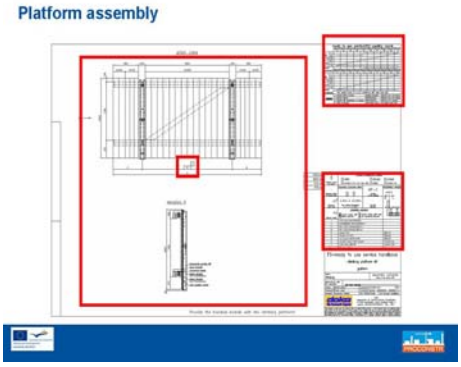
The next step in this evolution is the introduction of hydraulic units. The main elements of the formwork and the sequence of resetting is the same as with the climbing systems, but the crane can be used elsewhere.



The state of the art trend in this technology is making the systems cheaper. With the older generation of self-climbing every unit had to be equipped with its own set of hydraulic cylinders. Unfortunately hydraulic parts are very expensive and are only used when climbing takes place, otherwise they are useless. Engineers thought of a possibility to take the hydraulic parts off of the already moved units, then you can use them somewhere else. Unfortunately the systems get so complicated and expensive, that formwork companies give special certificates to operate them.



The assembly drawing of a platform for any climbing or self-climbing system is similar to those of wall formwork. The difference is in the used materials, you do not use plywood. Metal parts and wooden beams come from the product range of the system. Wooden boards are used as a walking surface (min. 5cm thick, unless local laws state differently).



Of course the whole formwork working cycle on a building site consists of few stages: forming, reinforcing, concrete pouring, stripping and cleaning. All of them are described in detail in **User information booklets/manuals**.

Formwork cleaning

The most often forgotten but very important part is to clean the formwork after stripping as soon as possible. The harder the concrete residue gets, the more difficult it is to remove. The dirtier the formwork is, the worse the finishing concrete surface gets and it requires more after-work with concrete cosmetics. Every manufacturer can supply the site with dedicated cleaning tools for their formwork.

Health and Safety regulations

As it was mentioned before platforms supporting formworks serve as working platforms for workers. In this way it is possible to obtain safety barriers on site placed at height.

France has the most restrictive safety laws in Europe but safety topic gets more and more important all over the world. It is another area of work on every building site that uses the knowledge and skills of carpenters. Beginning with cutting planks that are used as a covering of concreting platforms, through barriers on formwork and around the part of a building that is already built, finishing with temporary roofings over workplaces.

Of course it is possible to use different materials to make an effective safety barrier. If it is required you can use steel safety meshes or steel scaffolding tubes instead of wood. Plastic meshes can make an effective covering of the platform to prevent any objects from falling down. Even in systems like climbing windshields there are some tasks that can be performed by carpenters. The gaps between building slabs and the system profile should be covered with planks on hinges to make the system even safer.

SCP – Self Climbing Platform

The most advanced platform system up until now is the climbing platform. (SCP – Self Climbing Platform). It is a system used to build the highest constructions. It is an autonomic building site with all the materials, formwork and tools moved hydraulically on top of the building's core. The formwork is hung from top on special steel profiles, and is retracted on special rollers. It is surrounded with steel plates as a protection against winds but also workers do not see how high above the ground the construction takes place. This makes them more confident as they work their way up. The working platform is made of planks that make the perfect working surface. Also the gaps left open for the concrete pouring are covered later with planks when not in use.

So now, the climbing and self-climbing platforms, together with timber beam formworks are used on sites all over the world, not only to build skyscrapers, but also bridge pylons, cooling towers and water dams.

If you look closely at few of the pictures from the highest building in the world, you can see how much carpentry work there is on the modern building site.

As you can see, even with the most sophisticated formwork systems there is still a need for a good carpenter on a building site. People do not use wood as a construction material as often as they use to decades ago. It is still the cheapest and most flexible material and therefore it is best for all the additional works on every building site.

Chapter V TRAINING PART

An integral part of the module is the training section. It includes a three-day training cycle during which the following issues are subject to discussion:

Theoretical training (1 day)

Aims:

- to gain knowledge how to read assembly drawings; how to assemble modern timber formworks and where and why they will be used,
- to gain knowledge how to use carpenter tools and equipment,
- to gain knowledge about wood products and safety norms/standards.

Topics to be discussed:

- types of formworks,
- criteria for choosing a formwork system for specific site,
- specific type of formwork – terms and conditions of use,
- applied materials,
- tools,
- methods of climbing formworks assembly,
- methods of climbing formworks assembly,
- methods of formworks disassembly,
- formworks elements cleaning,
- Health and Safety regulations.

Practical training (2 days)

Workshops for two/three person teams.

Individual performance of all tasks as directed by an instructor, including:

First day of workshops

- Reading the assembly drawings.
- Appling formwork to specific project.
- Using of assembly bench.
- Using of specific materials (beams and profiles).

Second day of workshops

- Beams and profiles assembling.
- Formwork dismantling.
- Cleaning.

Summary of workshops, FAQs, remarks and conclusions

Test

1.	What are the basic materials used in modern formworks?
a)	Timber boards, timber logs, nails.
b)	Timber beams, plywood, steel profiles.
c)	Steel frames, multilayer plywood, wooden inserts.
d)	Glass or carbon fibres, wooden frames.
2.	Where is the highest building built with the use of timber formworks?
a)	Empire State Building, New York, USA.
b)	Burj Khalifa, Dubai, UAE.
c)	Lomonosov Institute, Moscow, Russia.
d)	Woolloomooloo Bay Wharf, Sydney, Australia.
3.	When was the first use of system timber formworks?
a)	18^{th} century, used to build the north wing of Versailles palace.
b)	2560 BC, while building the Koufu pyramid.
c)	1965, first used in Austria.
d)	1980, with the use of the first girder beam in Germany.
4.	How do you join plywood with beams?
a)	Screws, the plywood will not loosen when the formwork is used.
b)	Ordinary wood glue, it is easier to correct assembly failures.
c)	Nails, it is faster and therefore the labour is cheaper.
d)	Epoxide resin, it is hard to destroy an element.
5.	How to check if an element is rectangular?
a)	Simply by looking at the element.
b)	By comparing the lengths of element's edges.
c)	By comparing the lengths of element's diagonals.
d)	There is no need to do it.

6.	What does the SCC stand for?
a)	Stacking Corner Clamp.
b)	Self Compacting Concrete.
c)	Swedish Construction Council.
d)	Self Climbing Console.
7.	What are the criteria for choosing a formwork system?
a)	Price of the formwork.
b)	Is the formwork fireproof.
c)	Aesthetic value of the formwork.
d)	Technology restrictions.
8.	How big timber beam formworks can be put together ?
a)	9,0m^2
b)	72,0m^2
c)	120,0m^2.
d)	As big as you can imagine
9.	Materials used in panel formworks:
a)	Steel frame.
b)	Wooden frame.
c)	Steel panel.
d)	Plywood panel.
10.	The curved shape of timber panels is:
a)	Achieved by the use of shaping woods.
b)	Achieved by treating the plywood with steam.
c)	Achieved by bending the steel profiles.
d)	Not possible to achieve.
11.	What is a composite?
a)	An alternative word for composition in musical terms.
b)	An internet site about computers.
c)	A material made from two or more other materials.
d)	An American competition for site managers.

12.	What do you need the assembly bench for?
a)	To sit when assembling the panel.
b)	As a base for assembling few equal panels in a row.
c)	As a measure for putting all elements together according to plan.
d)	As a place to lay the plan on.
13.	Where do they have the most restrictive safety laws:
a)	Luxemburg
b)	Italy
c)	Germany
d)	France
14.	Why should you use screws for attaching the plywood instead of nails:
a)	They are cheaper
b)	It is easier to mount them than nails
c)	It is not allowed to use nails because of problems with changing of the ply
d)	The ply doesn't go off of the panel while formwork striping.
15.	With what means climbing systems are climbed:
a)	Moved by the workers manually with ratchets.
b)	By crane.
c)	Are taken apart and put together in the next casting step.
d)	With hydraulic units.
16.	What is the carpenters job on modern sites:
a)	Pouring the concrete
b)	Putting the formwork panels together
c)	Making of the safety barriers, roofings, platforms and coverings
d)	Carpenters don't have anything to do on a site nowadays
17.	What materials are most commonly used for safety barriers on sites?
a)	Wooden boards with a thickness of min. 2cm.
b)	Steel meshes.
c)	Plastic meshes.
d)	Steel scaffold tubes.

USEFUL SOURCES:

- www.doka.com,
- www.wikipedia.com,
- EN 338 Structural timber – strength classes,
- EN 13374 Temporary edge protection systems – Products specification and test methods,
- EN 13377 Prefabricated timber formwork beams- Requirements, classification and assessment,
- DIN 1052 Design of timber structures – General rules and rules for buildings
- Other European Standards,
- System User Manuals (e.g. Top 50) and calculation guides,
- Local work safety organization internet site (e.g. www.ciop.pl),
- Wood products brochures by wood manufacturers,
- Ministry of Infrastructure (http://www.mi.gov.pl),
- Ministry of National Education (http://www.men.gov.pl),
- General Office of Building Control (http://www.gunb.gov.pl),
- National Labour Inspectorate (http://www.pip.gov.pl),
- Central Institute of Labour Protection – National Research Institute (http://www.ciop.pl),
- Polish Craftsmanship Union (http://www.zrp.pl),
- Chamber of Polish Building Engineers (http://www.piib.org.pl),
- Polish Building Employers' Union (http://pzpb.internetdsl.pl),