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Building site Cleanliness and Waste Management

Guideline for EKE-Rakennus Oy

Helsinki Metropolia University of Applied Sciences

Bachelor of Engineering

Sustainable Building Engineering

Thesis

2 December 2018

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Title	Building site Cleanliness and Waste Management. Guideline for EKE-Rakennus Oy
Number of Pages	49 pages + 3 appendices
Date	2 December 2018
Degree	Bachelor of Engineering
Degree Programme	Civil Engineering
Specialisation option	Sustainable Building Engineering
Instructors	Liisamaria Happonen, Work and Project Manager Jorma Säteri, Head of Department
<p>The purpose of the final year project was to develop a building site cleanliness and waste management guideline for a construction company specialised in new accommodation projects. The project aimed at delivering theoretical and practical solutions for the company. The thesis is a situational analysis proposing adapted solutions which can be used now and improved continually.</p> <p>Regulations, directives, tools, and literature in the field of new accommodation projects were analysed and compared. Motivations and reasons for investing in building site cleanliness and waste management were considered. Four projects case studies of the company were observed and analysed under the form of graphics. Cleaning during the construction, final cleaning, and waste management costs are examined in interrelation with cleanliness and dust measurement monitoring and with the general schedule. Cleaning during construction, final cleaning, and waste management costs of each project are also examined through their own field. It is done according to the whole construction costs and operating costs, and according to target and realized costs.</p> <p>The results summarize the needs of the construction company and how to implement a guideline. It highlights the importance of existing cleanliness and waste management data. In opposite, it highlights the difficulties of developing adapted guideline and its implementation on site. Furthermore, the thesis suggests precise monitoring for perpetual and durable improvement for the company and more generally for the fields of the study.</p>	
Keywords	cleanliness, waste management, residential, building site, construction cost saving, cleanliness and waste management guideline

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Appendix 2. EKE-Rakennus Oy, building site cleanliness plan

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List of abbreviations

HVAC	Heating Ventilation and Air-Conditioning
RT	Rakennus Tieto. Finnish publication of information and guidance about construction.
VTT	Teknologian tutkimuskeskus. A Finnish multi-technology research institute of leading research applied in Northern Europe.
LVI	Lämmitys Vesi Ilmastointi. Finnish for HVAC.
P1 ja P2	Puhtausluokka. Cleanliness classes P1 and P2, where P1 is the strictest.
S1, S2 ja S3	Sisäilmaluokka. Indoor air classes S1, S2 and S3, where S1 is the strictest.
Hepa	High Efficiency Particulate Air Filter
BIM	Building Information Modelling
SFS	Suomen Standardisoimisliitto. A Finnish organization for standardization.
TR	Talonrakennus. Finnish for building construction.
MVR	Maa- ja Vesirakennustyöt. Finnish for ground and water related construction.
littera 8122	Cleaning and clearing during the construction cost
littera 8133	Final cleaning cost
littera 8114	Waste transports cost
littera 8	Operating costs
litteras 1-9	Total construction site costs
litteras 0-9	Total project costs

1 Introduction

The final year project looks into construction cleanliness and waste management for the construction company EKE-Rakennus Oy. As a part of its development, the company wants to establish a general guideline for building site cleanliness and waste management adapted to its own projects. Most projects of EKE-Rakennus Oy are new accommodation buildings in the Helsinki area. Their development focuses on the concept of loft which is an adaptable open space. The company is at the same time both the principal client and the main contractor. Moreover, renovation and demolition issues do not need to be taken into account.

The necessity of a cleanliness and waste management guideline for EKE-Rakennus Oy is partly based on its own operating needs and partly on environmental aspects. The current process and tools used by the company in various projects do not have any general guidelines with a similar vision that would be implemented in each project. Furthermore, the environment is an important issue in the building industry, especially in the construction. Generally, the environmental aspects of a project are considered at the planning stage of the project. In the whole project process, the construction phase is critical because the building is erected.

A construction project depends on three constraints: cost, time and scope. They are all interrelated and affect the quality of the project. Cleanliness and waste systems play a key role in reaching the defined quality in a construction project because they affect each constraint. The aim of this final year project is to implement consistent and feasible methodology and tools for each construction phases and for each player.

Usually, the subjects of cleanliness and waste management on building site are considered separately because they are important on their own, but in this thesis, they are combined as they interact, and affect each other. Due to the complexity of both subjects, the focus will be on what concerns the company, in other words, new construction for the private sector. Answering into the context of a specific company in the Finnish market requires general knowledge research into legislation, standards and tools available, and a baseline study throughout existing projects.

Two interrelated subjects are discussed below. The first subject is the construction site cleanliness, the second is construction site waste management. These topics are presented in three chapters. Chapter two introduces construction cleanliness and waste management in Finland and in Europe. Chapter three discusses four building cases. Chapter four combines the contents of the previous chapters to create an adapted construction site cleanliness and waste management guideline for EKE-Rakennus Oy. Chapter five discusses the conclusions that can be drawn on the bases of the study.

2 Construction cleanliness and waste management

2.1 Construction site cleanliness in Finland and Europe

2.1.1 Construction site cleanliness generalities

Construction activities create various types of dust which is often a health hazard. Figure 1 shows what kind of dust is caused by various construction stages, as well as where the dust accumulates. Figure 1 highlights the way the various types of dust affect each other. Thus, it shows what type of dust is the most prevalent one. The connections between a work stage and dust generation, as well as the places that collect dust are my own observations. Dust from concrete, cement, wood, stone, and mortar are the most frequent dust types. Corrections and finishing tasks, such as grinding, smoothing and surfaces works, cause a majority of the dust types. All of them cause health problems [1, 2.]. Caring for construction cleanliness is more than improving comfort, it can save lives. Diseases caused by dust are numerous and depends on the type of dust and its components, and range from skin, eye, respiratory or lung problems to cancers. Dust accumulation in some areas are easier to handle than in others. It is more convenient to clean the dust which is on the floor than dust in technical spaces, such as false ceilings and air conditioning equipment.

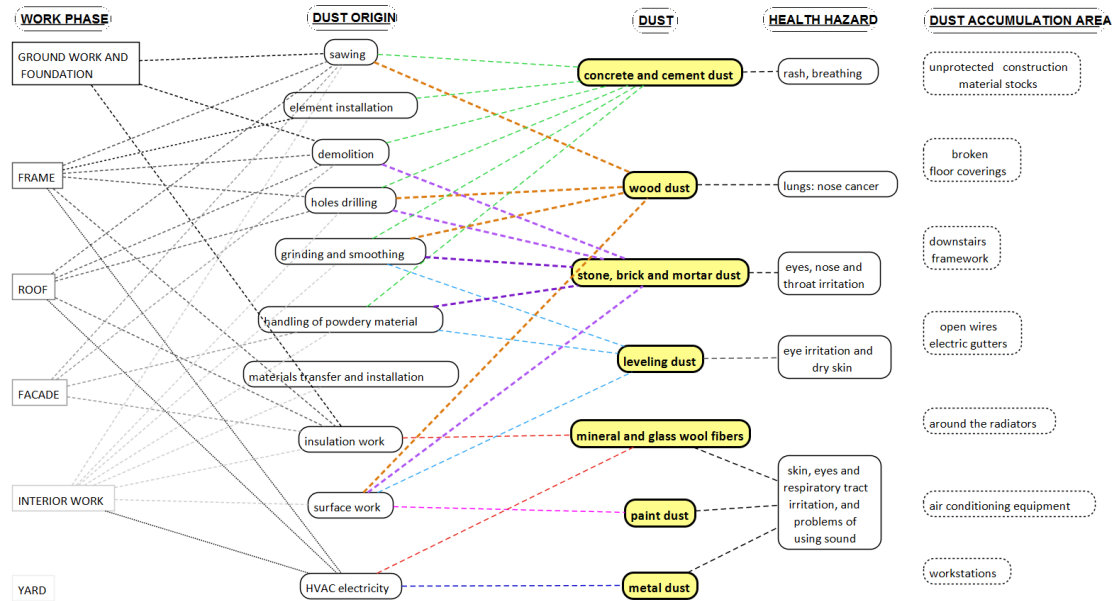


Figure 1. Dust types and characteristics per construction stages [1, 2].

Failure in dust avoidance and dust protection, or either of them, has direct and indirect social and economic consequences. Dust and its spreading, as well as the costs of its cleaning may be higher than dust avoidance itself. Dust can slow down the project and shorter the equipment life time, which means extra costs not considered at the planning stage of the construction project. Dust can even cause accidents. Dust can also cause several occupational diseases in the workers. Resulting absenteeism which is an extra cost. More globally, the environment can be affected. Dust can damage third parties and indemnities can be required. [2.] Hence, dust can cause extra costs and affect the whole project, its cost, time and scope.

2.1.2 Current situation and regulation

The Finnish Building Code, Decree 1009/2017 governs dust but only from the Heating Ventilation and Air Conditioning (abbreviated as HVAC in Finnish documents. The HVAC abbreviation is used from here on in this thesis) view point. It mentions that protections of ventilation system must be removed only after cleaning, when no dusting works is done in the space. The ventilation system is the most difficult and costly place to clean. Furthermore, it is the system which spreads the biggest quantity of dust. Yet, relevant actors involved in a construction project are more various and dust affect each field of the construction project. They are also architects, structural and electric engineers and the constructor. As an example, dust can be a factor of fire from the electrical system or

dust can affect the quality of the materials. Thereby regulations could be more extensive. However, it assesses a basic rule which is to produce a clean ventilation system, install it, clean it and keep it protected until the final cleaning stage. [3.]

Section 70 of the decree Occupational Hygiene Factors from Government Decree on Construction Safety 205/2009 includes more aspects about dust in construction. There must be sum-up dated list of the chemical products used visible on site. If there is too much dust, some techniques to avoid their spreading are mentioned, such as space subdivision and pressure differential. However, the decree does not specify what is too much. [4.]

Almost all the information about dust at a building site is given in some Finnish guides, such as Ratu-kortti for the production planning, Rakennus Tieto for the construction industry (abbreviated as RT-kortti in Finnish documents. The RT-kortti abbreviation is used from here on in this thesis) and Lämpö Vesi Ilma-kortti for Heating Ventilation Air-Conditioning (abbreviated as LVI-kortti in Finnish documents. The LVI-kortti abbreviation is used from here on in this thesis) [5.]. Rakennus Tieto is a Finnish publication of information and guidance about construction. RT-kortti is a Finnish publication about building construction. LVI-kortti is a Finnish publication about Heating Ventilation Air-Conditioning. At present, legislation concerning dust on a construction site is virtually non-existent. Nevertheless, it is possible to follow the specific cleanliness class P1, discussed below on a site. The use of the cleanliness class P1 is a choice of the owner of the project or it can be a requirement for a specific type of project.

There are two building-site cleanliness classes which are cleanliness class P1 and cleanliness class P2. Cleanliness class P1 has the highest level of cleanliness and cleanliness class P2 the lowest. Cleanliness classes come from the Classification of Indoor Environment which defines three indoor air classes which are indoor air class S1, S2 and S3. Indoor air classes S1 or S2 depends on cleanliness class P1 and indoor air class S3 depends on cleanliness class P2. Indoor air class S1 has the highest air purity and S3 the lowest. Indoor air class S1 quality is defined as an individual indoor environment, indoor air class S2 as a comfortable indoor environment and indoor air class S3 as a satisfactory indoor environment. Usually residential buildings require the indoor air class S3, public buildings such as offices or school S2 and specific public buildings such as hospital S1. [6.]

Indoor air classes affect the project planning, building site organisation and the hand-over. Cleanliness class P2 program and target are not precise. They mainly mention a procedure consistent with good building practice. Instead cleanliness class P1 is depending on numerous requirements. The following chapter presents the impacts of the building site cleanliness classes P1 and P2 during the two phases of cleaning: cleaning during the construction and final cleaning. [6.]

2.1.3 Effects of indoor air classes on cleaning during construction work

Indoor air classes S1 and S2 have an impact on the interior environment planning and technical drawings of the construction project. Yet, there are specific requirements for the choice of the material and HVAC equipment, and the temperature, acoustic and lighting target inside the building. During the construction, indoor air classes S1 and S2 require the collection of documentation that includes the emission classification of the materials that is, product descriptions and operation instructions. Indoor air classes S1 and S2 are presented in the quality plan of the construction project. During the bidding, they refer to the project contracts document. Cleanliness class P2 does not have any requirements for the planning phase of the project. [6.]

Cleaning tasks during construction can be divided into three categories: prevention of dust generation, dust propagation avoidance and removal, and dust protection. Cleanliness classes P1 and P2 implementation into those three categories is explained in the following paragraphs.

When dust generation is to be presented, cleanliness class P2 separates outdoor smoking area, not doing dirty tasks in walkways and clean areas and dust-free cleaning methods. This is a good building practice. Cleanliness class P1 requires much more attention than cleanliness class P2. Before a worker may access a building site, the cleanliness class P1 is introduced and explained to him/her. Dust-free materials and working methods are chosen if it is possible. If it is impossible as well as impossible to implement the dusty task outside, it is recommended having a more precise plan, dimensions and pre-smoothing stages. The purpose is to minimize errors and corrections which can create dust on the building site. In any case, separated workstations are to be allocated for dusty work phases. Furthermore, the building under construction is divided into smaller compartmentalized areas. Each space is cleaned regularly and protected if necessary, especially passageway spaces which are corridors, stairs and elevators. Exterior area is

tidy before interior construction stage starts. Unnecessary movement between clean and dirty spaces are to be avoided, and openings are to be held closed. Tools are to be equipped with local exhaust and vacuum cleaners with fine particulate filters. Materials and equipment are to be maintained in good condition, stored in a dry place, protected and immediately repaired if necessary. Storage is to have its own place. Excessive quantity of material is to be controlled. [6.]

About dust propagation avoidance and cleaning, cleanliness class P1 highlights compartmentalization, protection of installed surfaces and vacuuming often. Tools must be connected to a central vacuum system. Both cleanliness classes prohibit sweeping because it propagates dust. [5, 6.]

Concerning dust protection, cleanliness class P1 mentions the use of respiratory protection for workers during dusty work, as well as the protection of material from dust and humidity. [6.]

2.1.4 Effects of indoor air classes on final cleaning

As illustrated in figure 2, final cleaning is divided into two main stages, one before and the other after ventilation operation tests. After the first stage of final cleaning, dusty work cannot be carried out anymore because ventilation tests start. There are two inspections that measure the dust accumulation. The one before the ventilation operation tests proceeds to introduce the space of the project to the building supervisor. The second test is done before the building handover. To reach cleanliness classes P1 and P2, the final cleaning tasks are basically similar, but they do not have the same arrangement, precision and target. [6.]

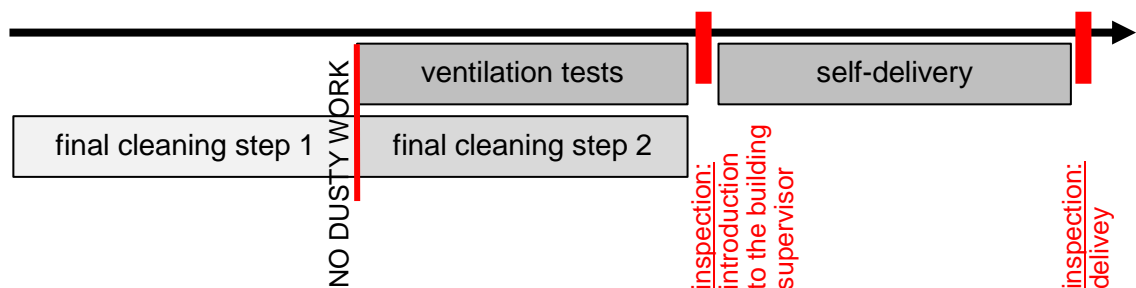


Figure 2. Final cleaning work stages and inspections planning [6].

The tools used for cleaning are a vacuum cleaner with a fine dust filter High Efficiency Particulate Air Filter (abbreviated as Hepa in Finnish documents. The Hepa abbreviation is used from here on in this thesis) and other products and equipment for good cleaning. The purpose of the Hepa filter is to trap at least 99, 97% of particulates down to the size of 0,3 microns, which is the size of the smallest bacteria. [5.] Figure 3 shows filters according to the characteristics of particles. Possible cleaning tools are detailed in chapter 2.1.5.

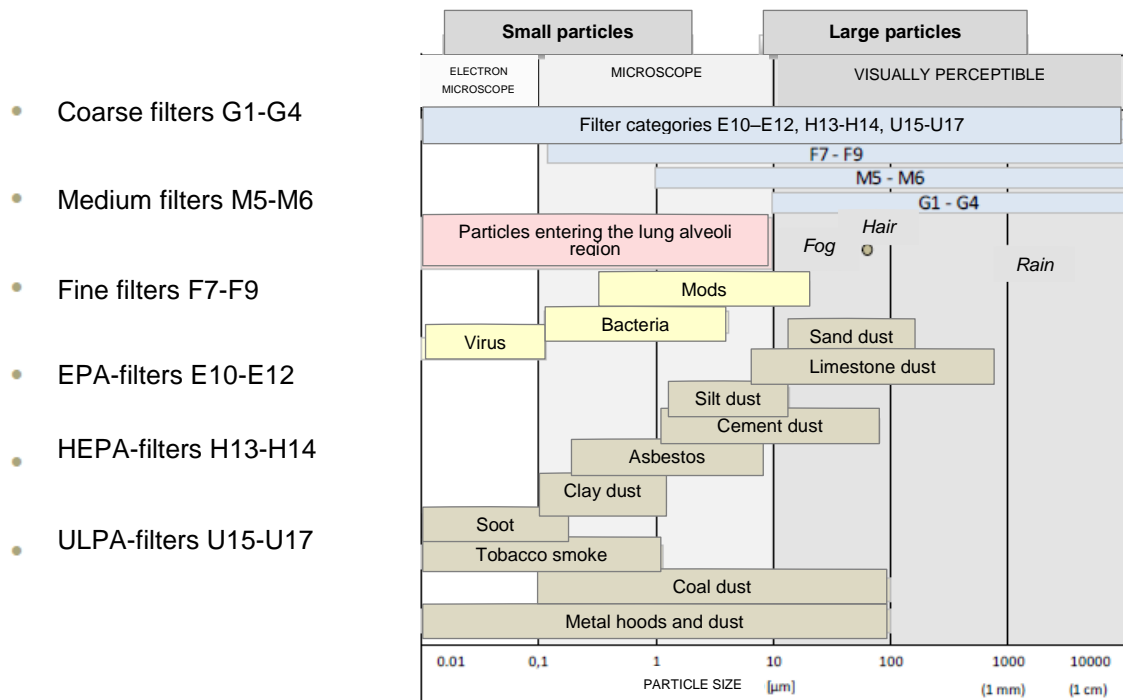


Figure 3. Different filters according to particle sizes and types [8].

Before a construction site can claim to follow the regulations of cleanliness class P1, smoking is strictly forbidden in any interior space. Vacuum cleaning is done in passage-way spaces and a dust-free environment is maintained with regular cleaning (twice the week). [6, 7.]

Once the construction is completed the site must be cleaned. In both cleanliness classes, the tasks before final cleaning are the removal and disposal of protection. If the site has followed the rules of cleanliness class P1, it is done two days before starting final cleaning. Before final cleaning, vacuum cleaning is done and after that only dust-free tasks can be realized. Working methods are mentioned in the work contract documents and work plan for subcontractors. [6.]

In the cleanliness classes, the tasks for the first stage of final cleaning are different. If the site has followed the rules of cleanliness class P2, the instructions dictate that after the final cleaning is begun, only dust-free tasks can be carried out. The rules for the first stage of final cleaning in cleanliness class P1 are more specific. The first areas to be cleaned are surfaces that are above 180 cm, such as casing, ceiling, cover strip, lighting and ventilation equipment. Only after that are surfaces beneath the level of 180 cm cleaned as floor, windows and doors surfaces. No program defines the cleanliness class P2, just a good way of building. On the other hand, cleanliness class P1 instructions define first inspection requirements. The dust concentration cannot exceed five percent for the surfaces over and under 180 cm. Places to control are ceilings, walls, furniture, floor surfaces and electric gutters. [6.]

Table 1. Cleanliness classes P1 and P2, permissible dust concentration [6.]

Inspection time	Cleanliness class P1		Cleanliness class P2
	Surfaces assessed	Dust concentration (%) (SFS 5994 INSTA 800)	Good building practice
Before ventilation operation tests	Above the suspended ceiling surfaces	5	
	Visible surfaces and furniture inner surfaces		
Before the building delivery	Visible surfaces and furniture inner surfaces	1	
	Floor surfaces	3	

The second stage of final cleaning, according to the rules of cleanliness class P2 consists of wiping the surfaces a second time and cleaning windows and furniture when the installation work is half-finished. The final control is done eight hours after the installation work is completed. Cleanliness class P1 specifies that the cleaning is to be done with a humid rag, and the area to be cleaned is the floor. Clean areas are locked after cleaning in order to remain clean. Yet, the level of cleanliness must be maintained. The walkway spaces are vacuumed twice a week. During transfer-standby or self-delivery, dust concentration on the ventilation inner surfaces of ventilation ducts and devices cannot be over 0,7 g/m² in cleanliness class P1 and 2,5 g/m² in cleanliness class P2. The second

inspection according to cleanliness class P1 is rated by the quantity of dust concentration. The concentration must be under 1% on visible surfaces and inner surfaces of furniture, and under 3% on floor surfaces. The surfaces to be assessed and the dust concentration limits for both inspection times are presented below in table 1. [6.]

For cleanliness class P1 purity assessment calls for evaluating fat and spots visually two hours after cleaning at the earliest, and surface dust concentration is measured with the gel tape method SFS 5994 INSTA 800 (SFS is the abbreviation of Suomen Standardisointiliitto in Finnish documents. The SFS abbreviation is used from here on in this thesis). SFS is an organization of standardization. Cleanliness class P2 evaluation is done visually. [6.]

2.1.5 Cleanliness tools and plan

There are plenty of cleanliness measurement tools and some have some particularities. The tools discussed in this final year project are presented below.

Congrid is a mobile application that is used for both data collection on site and data communication from site. The data collected are observations, Talonrakennus (Finnish for building construction, abbreviated as TR in Finnish documents. The TR abbreviation is used from here on in this thesis) and Maa- ja Vesirakennustyömaa (Finnish for land and water works, abbreviated as MVR in Finnish documents. The MVR abbreviation is used from here on in this thesis) performance measurements, quality, safety observations, photographs, notes and identification of information on plans. The tool makes communication easier thanks to the use of pictures and its identification on plans. The difference with other measurement tools is the use of plans which can show the critical areas. The tool saves time, improves control, cost efficiency, safety and quality. [9.] TPA Andersson Oy is an expert in cleanliness class P1. The company can execute dust measurement from the construction to delivery in demolition, renovation and construction projects. The measurements are based on Indoor Air Classification 2008. [10.]

Main tools used to remove dust are industrial vacuum cleaners and central vacuum cleaning systems. Both systems have fine particulate filters (Hepa). A central vacuum cleaning system should replace a basic vacuum cleaner. Central system facilitates the work because it is installed in a single place, that can be for an example under a staircase to save space. A central system causes less noise pollution because the motor is not in

the place where the vacuum is used, only the hose is moving. The system maintenance only requires the service of one unit in one place while the use of industrial vacuum cleaners requires a bigger quantity of units. In addition, a central vacuum system can be used simultaneously in different areas with several hoses. The system also creates negative pressure in the cleaned space thus preventing the spreading of dust. Moreover, the suction of central vacuum system is powerful. In a nutshell, a central system improves both cost efficiency and quality of work environment. [10.]

A company to offer patented systems for workplaces that create a lot of dust is Consair. The patented systems are efficient for cleanliness class P1. They supply both passive and active equipment for dust management. The passive system is meant to supplement the active system as a kind of back-up system. As its name suggests, the passive system does not need any people to use it. Examples of passive systems are ventilation, partitioning or under-pressure system. The systems are equipped with a filter. The main purpose is to avoid the spreading of dust. It is practical to separate a space where dust is produced from other areas, and an under-pressure system allows dirty air to be filtered to obtain clean air. [11.] An active system, on the other hand, requires participation of workers. It is a local exhaust ventilation system, which can be based on either high or low pressure. The Consair system is called CAMU. It is a Finnish innovation, a workstation based on low pressure, used for dry dusts. It works without a vacuum or subdivision. It moves a large quantity of air to prevent 99% of the dust mass from being inhaled by workers. The system has a pre-chamber equipped with a by-pass to reduce the dust accumulation in the filter. Additionally, this filter has a maintenance-free which both increases its life duration and saves time. [12.]

Industrial air purifiers can be used as a cleanliness tool. As an example, Trotec, a German company has developed a series named TAC. It can be used with different filters that can be assembled according to the degree of air pollution. The TAG filtration process ends with a fan or a Hepa filter. [13.]

There are also some tools such as a circular saw which can be directly connected to a vacuum cleaner, and some that have an integrated dust extraction collector, like for example a hammer drill. All the dust created are immediately taken away from the work site. Dust cannot be spread; its quantity is reduced by 99%. Due to a better work environment, work speed increases by 20%. The life time of electrical tools is increased to be 60% longer, and the life time of accessories 20% longer. The choice of working tools

of course depends on the subcontractors because they use their own equipment. However, the obligation using tools with an integrated dust extraction collector can be mentioned in the subcontractor contract. The technology reduces the need of dust cleaning which is work paid by the main constructor. [14.]

A new cleaning tool, a cleaning robot for construction sites is currently being prototyped. It functions with a Building Information Modeling model (abbreviated as BIM in Finnish documents. The BIM abbreviation is used from here on in this thesis) and has a 3D camera. Thus, it can avoid obstacles. The robot is researched and created to increase the cost efficiency in dust management; were it to be a success, it would considerably decrease the cost of constant cleaning work, now done by people. [15.]

A construction site should have a dust management plan that shows the floor plan and passages of the site, the schedule and map for work that creates dust, a listing of dust control measures, the person responsible for dust control on site, the content of dust control introduction to the workers, and the building site diary. This diary should show the dust monitoring and the measures taken. [16.] It can also include cleanliness class P1 specificities and if necessary, dust costs related to subcontractors' responsibilities.

The expected costs for dust control in new construction should be calculated including the cleaning work itself both during the construction and final cleaning, the material needed to avoid the spreading of dust, such as under pressuring and compartmentalization equipment, the material for cleaning such as vacuum cleaners, and the protection and measurement equipment.

2.2 Construction site waste management in Finland and in Europe

2.2.1 Construction site waste

Waste consists of used products. They have different life stages and so different aspect which are the material, packaging and material loss. The products used on-site consume a lot of construction resources, such as space, labour and time. Yet, the waste system on a building site is more than processing and collecting waste. The stages of material and waste treatment include transportation of the material to building worksite, material reception and storage, demolition of package, transport of material to workstation, waste

collection and sorting in each floor of the building and into the waste containers, sorting and processing, storage on site and transport of waste to the waste station. [17.]

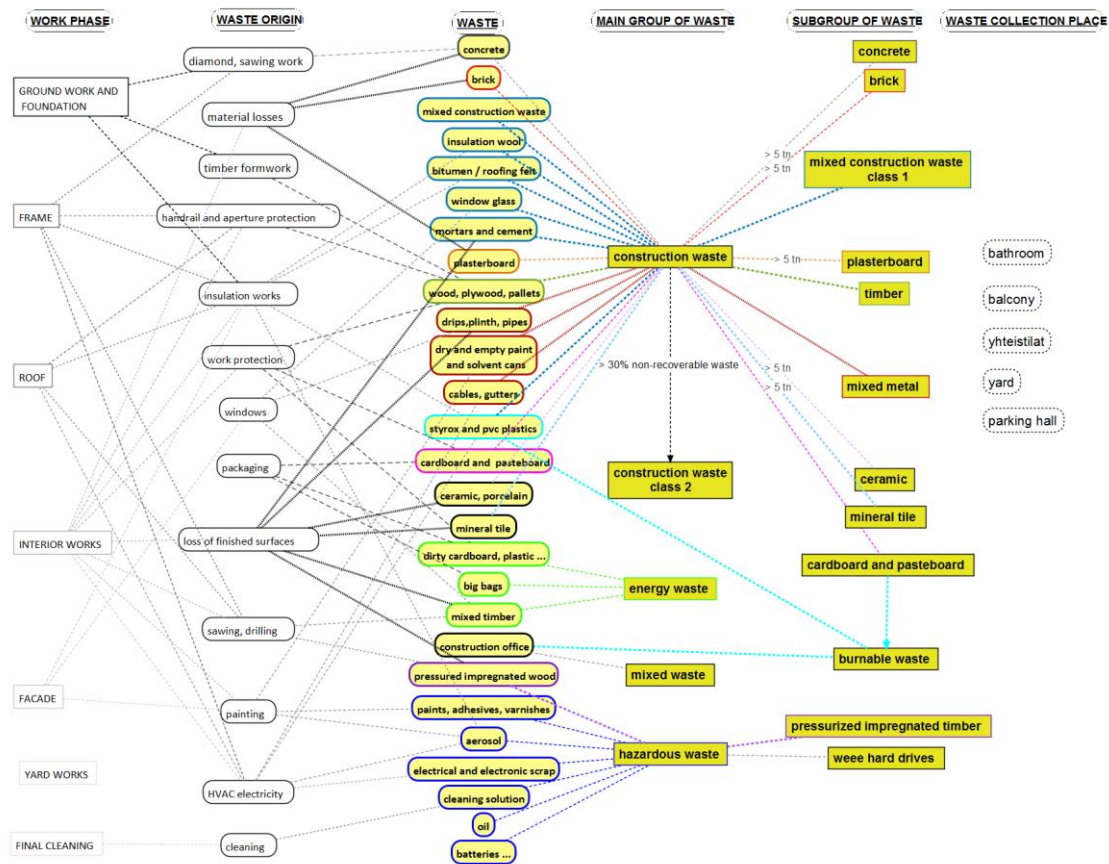


Figure 4. Waste types and characteristics per construction stages [18.]

Figure 4 introduces waste sources in terms of types of waste, sorting and sub-sorting groups, work stages and specific task categories and accumulation places. The data have been gathered from various sources and own observations, and combined in figure 4. The observations about the connection between work stages and waste generation as well as their collection places have been made on various construction sites. Most types of waste are a result of finishing surfaces due to material losses, compartmental structures, safety and quality protection of the materials. Prefabricated elements (concrete or wood) reduce waste production on-site because they involve less transformation work. Most waste is generated in repairs and modifications. Insulation waste is the type of waste most difficult to recycle. In accommodation projects, living spaces are the most important area in the construction planning. Other spaces, such as bathrooms, balconies, common spaces, garden and parking plots are often used as a storage area, and may become waste accumulation areas. [18.]

The price of waste management is the sum of waste processing and waste collection costs. It also includes the rent of the collection containers and the reception on-site. Processing tasks may be sorting, recycling if possible, reusing or transformation. [18.] The waste processing prices from previous projects (table 2) highlights that sorting almost each waste is cheaper than construction waste class 1 and 2 and mixed waste. As illustrated in figure 4, construction waste can be sorted as: concrete, brick, plasterboard, wood, metal, ceramic, mineral tile, cardboard and construction waste. Construction waste is the waste from the building site that is not sorted. Class 1 means that there is more of 70% of recoverable waste and class 2 less. Mixed waste can get each waste from the office. The price of separated concrete waste is more advantageous than that of unsorted concrete waste. The same is true for wood waste. Metal waste is a special case because metal is reused and has no processing price but a buying price. It is the only positive waste. Hazardous waste processing is costly, but It is mandatory to separate it. It is also highly harmful for the environment, which is why it should be avoided. [18.]

Table 2. Waste processing price per ton in Finland on certain construction sites

waste type	processing price €/ton	waste type	processing price €/ton
Sorted separately:			
concrete waste < 0,5m	20,6	combustible waste	135
concrete waste < 1m	24,28	construction waste class 1	105-158
concrete waste 1-5m	35,04	construction waste class 2	185
concrete waste + brick	50,53-53,06	special treatment waste	152,25
light concrete	69,9	energy waste	72-75
wood waste	5-29		
mixed wood	36-49,35	Hazardous waste:	
metal > 50 kg/week	0- (- 80)	saturated wood	230,64
plasterboard	/	weee-hard-drives	500

Failure in waste management causes extra costs due to much material losses, packaging and waste. Lack of waste sorting increases direct waste management costs. As mentioned above, waste is also a material according to the stage of its life cycle and requires transportation, storage and work from site workers and foremen. These are the indirect costs, not taken into consideration in the expected project costs. [17.]

2.2.2 Current situation and regulation

In Europe, waste generated by demolition and construction business represents between 25 and 30% of the total waste. The general European policies aim to develop the recycling and re-using market that have a high potential. The purpose is to develop green nations. Consequently, sorting is a tool to reach this objective. [19.] In 2012, the total amount of construction waste in Finland was about 16 million tons or about 18% of the total Finnish waste volume. In 2015, the amount was about 15 million tons or 14.4% of Finland's total waste volume. [17.]. In Finland, waste from construction decreases. New construction of residential buildings creates between 6 and 11 kg/brm³ of waste. It is much more than for offices and much less than for detached houses [18.]. Accordingly, the management of waste from residential building has an important role in the overall European ambitions.

Legislation and regulations on waste management are more numerous than those which regulate cleaning. Waste management has a greater impact on the environment and on the city. Also, it is easier to measure waste quantity than dust.

The Waste Decree 179/2012 indicates at least eight categories for construction waste sorting: concrete, brick, mineral, and ceramic waste, gypsum-based waste, unsaturated wood waste, metal waste, glass waste, plastics waste, paper and board waste, and land and rock waste. [20.]

The general waste management regulation concerning construction in Helsinki Area is, however, more stringent. There are waste weight limits over what the mentioned waste below must be separated. Concrete, brick, mineral, ceramic and gypsum waste must be sorted if the construction waste exceeds 5 tons. An average construction project of a block of flats exceeds this limit. Moreover, unsaturated timber waste, metal waste, and cardboard waste, must be sorted if each one weighs more than 50 kg per week. Hazardous waste must be always collected separately. [21.]

If an important construction project produces more than a hundred tons of waste per year, the wastes should be recorded. For example, the quantity of each type of waste is reported for each month. [22.]

The optimal solution in waste management is to minimize waste production. Ministry of Environment has detailed this idea for each construction phase from the design to the construction. Minimizing waste production involves a clean workplace, good tools, and working methods. Yet, cleaning maintenance affects the waste production because a product which should be used on-site as a material could be damaged and then become waste. [23, 24.]

Some waste management companies classify construction waste into two classes. Class 1 has less and class 2 more than 30% of non-recoverable waste. Class 2 waste processing is more expensive than class 1. Non-recoverable waste includes insulating materials, fiber, glass, plasterboard, PVC, mattresses, window glazing, and contaminated sawdust. It cannot contain household appliances, electric or electronic waste, vehicle tires, waste containing gases or liquids, hazardous waste, asbestos, contaminated soil, seepage wafers containing lead and heavy metal products. It is better for the environment to avoid class 2 and to sort as much as possible of the construction waste. [25.]

The latest European waste directives (2008/98/EY) follows sustainable development goals. The member states are to promote waste recycling so that at least 70% of construction and demolition waste are recycled in 2020. It is why some waste management companies use construction waste class 1 and class 2. The purpose of the directive is that class 2 disappears because it contains over 30% of non-recoverable waste. Recoverable waste can be processed in a different way, but in priority order must be the reduction of harmful waste, reusing waste, waste recycling, waste transformation into energy, for example. A landfill is the last choice. [26.]

In the same way that for cleanliness regulation in chapter 2.1.2, some specific guides used in Finland, such as “Ratu-kortti” for the production planning and “Rakennus Tieto (RT-kortti)” for the construction industry, clarify the waste regulation by illustrating and summarizing their objectives and contents.

2.2.3 Waste organisation and management tools

At a construction site, the number and capacity of waste containers, as well as their transport must be big enough and optimized at the various stages of construction. Overfilling trash must be avoided by daily control. [18.] Collection equipment, presented in

figure 5, is a fixed skip bin (volume minimum to maximum $\approx 16\text{-}37\text{m}^3$, maximum permissible load 1,5-13tn). A skip bin can be moved by a tower crane. It is an intermediary model between a waste tilt truck or a wheeled garbage and a garbage truck. [18.]



Figure 5. Collecting bins on a building site [16.]

The sorting containers presented in figure 6 are a waste tilt truck with a maximum permissible load of 150-200kg, 200-400L, a wheeled garbage waste cart with a volume of about 8-37m³ or 140-1000L and a cardboard waste trolley which can be moved by a single person. The purpose of wheeled garbage containers is their mobility and the diversity of sizes which offers flexible use. The cardboard waste trolley is also mobile and adapted to the shape of the waste material. The waste tilt truck can be parked outside, contain bigger waste quantity and be moved by the tower crane. [18.] Each container has its own usefulness and position on the construction site. Their size varies according to the waste management company.

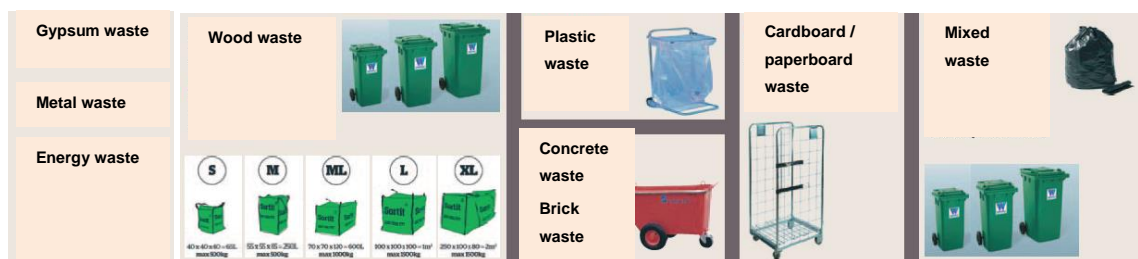


Figure 6. Sorting bins available according to the different type of waste [17.]

There is a distinctive difference between interior and exterior construction at a work site. Exterior construction consists of groundwork and foundation, frame, facades and yard construction. Interior construction includes partition walls, painting, tiling and furniture installation. It is important to discuss their waste management separately because the

conceivable equipment size is totally different. Furthermore, the waste types created in exterior and interior construction are different. [18.] The filling of the waste bins and the drainage rhythm should be monitored. The required changes should be made. A correct quantity and size of containers in right places is needed with spatial and temporal controls (sorting will not take more space because smaller collection bins can be used).

There are also companies that collect extra materials to be reused, such as Netlet Oy AB for example. Therefore, usable material are not thrown in the waste containers. It is a service free of charge, so it saves money when there is no need to pay for collection and processing. There is no restriction as to the amount of waste, but common sense should be used so that the material can be reused. Furthermore, the recycling company delivers a specific report for environmental reporting. The company sells the collected material at a discounted price. This system is positive for both parties and also to the environment and people who buy the recycled materials. [27.]

On the construction site, there should be waste management plan that shows the origin of the waste by the work stage, waste type, quantity, as well as available collecting equipment, sorting containers, waste collection points, lifting paths, sorting procedures and practices, and also collecting needs and scheduling. The plan also mentions the waste reporting plan. [18.]

At a new construction site, the expected waste costs should be calculated from the value and transfer of the material losses. The expected costs calculation should take into consideration the cost of waste sorting and transfer, cleaning, collection fees and transport, foremen organization and waste containers. [18, 17.]

2.3 Reasons for investing in cleanliness and waste management

The practical goal of investing in dust and waste management is to reduce the generation of dust and waste on construction site. It is done by anticipating the generation of dust and waste and preventing protection from dust and waste. This goal requires investment of resources, such as time and money to obtain a return on investment in terms of time, money and quality. The quality expected for dust and waste management determinates the level of investment.

The amount of construction waste reduces year after year. The amount of dust is not measured at present, but it could be done by the following number of projects applying cleanliness class P1. Directives concerning cleanliness and waste management in construction projects are getting ever more restrictive. Remaining regularly informed and updating work methods helps the company to progress and even more, to improve their image. Not to mention that it preserves health and environment.

Consair Oy has conducted a survey about the motivation of dust management on a construction site. Most of the respondents, 67% of them, from workers to the supervisors, considered that the most important reason for dust management is occupational health. 25% of constructors and site managers think that the main reason for dust management is quality, and 8% believe that the main reason is cleanliness and purity of the site. The survey questions about the necessity of a dust manager on construction site who could be represented by the principal client or supervisor. Yet, they should feel involved in the subject of dustiness and see themselves in a key role in demanding better dust management because it is highly important to the final outcome of the project. At present, it looks like they do not see themselves as a dust manager. [28.]

To control the benefits of cleanliness and waste management, it is essential to be aware of what influences the performance and quality of cleanliness and waste management. Cleanliness and waste management plans are depending on both design and construction phases of the building project. Design phase affects cleanliness and waste management through material choices, the design of surfaces, the airtightness of the building, the indoor air classes S1, S2 or S3 choices, and the correct design of the building without modification. Avoiding design modification involves good communication between all designers, subcontractors and naturally the main contractor. The construction phase affects cleanliness and waste management through the assessment of cleanliness classes P1 or P2 related to the required indoor air class, the good construction schedule which minimize the use of material protection, accurate calculation of material quantity which reduce material losses and right waste containers.

As demonstrated in chapters 2.1 and 2.2, cleanliness and waste management impact on construction both directly and indirectly. They have an effect on safety risks because they reduce the risk of accidents like fire and falls. They save time because it is easier to move materials and people and it makes easier the well-doing of construction tasks. Ultimately, each subcontractor handover is done in time. They economize costs because

it is cheaper to sort waste than not, it minimizes material loss, and it improves work efficiency due to a good work atmosphere and workers health. They improve construction quality, especially interior finishes and indoor air, which means better health for users. All in all, cleanliness and waste management promote the corporate image.

Paying attention to cleanliness and waste management improves the work performance because it has a systemic impact. It interacts both directly and indirectly with other fields of a project and with the four project parameters time, costs, scope, quality. Generally, the quality demand of a project improves the construction process and results. A construction project also impacts on matters outside of the projects, such as the health of the workers, the future users, and the environment. Overall, the quality demand of a project has an impact on society.

3 Project case studies

3.1 Analyzed projects and tools used

The four analyzed projects are new accommodation in Helsinki area. They are:

- Case 1: Vantaa, a six-storey block of flats.
- Case 2: Vantaa, a loft-type seven-storey block of flats.
- Case 3: Espoo, a six-storey block of flats.
- Case 4: Kirkkonummi, a set of detached, terraced houses and a two-storey block of flats.

Table 3. Building characteristics.

Project	Built in	Staircases	Type	Gross area	Ground area
Case 1	2017	1	block of flats (40 flats, 7 floors)	3170 m ²	1110 m ²
Case 2	2017	1	block of flats loft (7 floors)	3255 m ²	1440 m ²
Case 3	2018	2	block of flats (47 flats, 6 floors)	5270 m ²	3079 m ²
Case 4	2017		terraced houses and block of flats (2 floors)	3385 m ²	13 584 m ²

Table 3 and table 4 show some characteristics and technical data about the cases. Cases 1, 2 and 3 are similar projects, in the way that they are a six or seven floors block of flats. What is particular in case 2 is that it is a loft project which involves higher ceilings and therefore, more safety issues. The difference in case 4 is that the project is terraced houses and a two-floor block of flats with a large ground area. Each case constructed with prefabricated elements, mainly concrete. Hence, it minimizes work done on-site.

Table 4. Building technical information.

Project	Heating system	Main structure material	Roof type	Roofing materials
Case 1	district heating	concrete elements		bitumen membrane
Case 2		concrete elements	flat and lap roof	laminated veneer lumber + bitumen membrane
Case 3	district heating	concrete elements	flat roof	laminated veneer lumber + bitumen membrane
Case 4		wood (major) and concrete elements	tapered tin roof	

Various type of data sources for the project case studies are analyzed both independently and together. The purpose is to get a global view about the balance between the cost, time and scope of the project which must achieve its quality demand. The data sources are the schedule of main construction phases, the construction work safety measurement called “TR-mittaus” (Talonrakennus), the cost of cleaning during the construction, the cost of final cleaning and the cost of waste transports. Description of the data sources for the case studies are presented below.

The schedule of main construction phases for each project case study is illustrated by a Gantt chart which is a project schedule. The time is on the x- axis and the tasks are on the y-axis. This Gantt chart points out the interaction of ground and foundation phase, structure phase, façade phase, yard phase, interior phase, and handover phase.

The construction work safety measurements were performed on a weekly basis on-site in each of the case projects. These results are shown as a percentage based on seven indicators: safety of worker, racks, walkways and ladders, machinery and equipment, fall

protection, electricity and lighting, organisation and waste disposal, and amount of dust. The highest is the percentage, the safest is the construction site. This study looks into organisation and waste disposal, and amount of dust. The total percentage of work safety measurement is also considered to see if the organisation and waste disposal, and amount of dust have a big impact on the safety level. The percentages point out the construction stage at which there are or not issues with organisation and waste disposal, and amount of dust. Project safety measurement at EKE-Rakennus Oy is conducted with the the program Site Manager. It includes pre-written problems and site pictures, so it is precise, easy to use, easy to collect and communicate information. The company has also used a paper form, out it is imprecise because it is impossible to include all observations as well as pictures.

In a construction project, each cost is categorized, and its sum is the total cost of the building project. Each category is a unit of account called littera. Cleanliness and waste management costs are some of the cost categories of the project, littera 8122 for cleaning during the construction, littera 8113 for final cleaning and littera 8114 for waste collection costs. These costs are part of the operating costs of the project, littera 8, and the operating costs are part of the construction costs of the project, litteras 1 to 9. Cleaning and clearing costs are generated during the actual construction. They include subcontractors work, material rented or bought and company's own work. Final cleaning is the final work stage before delivery. The cost of final cleaning consists of subcontractors' work. The cost of the cleaning tasks for the project case studies is depending on cleanliness class P2. Waste transports costs are also generated during construction. They include waste processing, transport, containers and receipts fee from waste management companies. The receipts show when, how much and what waste is handled, and the part of the waste cost resulting from its processing and its containers.

For each project case study, data referring to the cleanliness and waste management of the project are shown in a graphic form, presented in the following chapters. In each graph, the x-axis shows the time and the y-axis shows either the construction tasks, work safety measurements percentages or costs. The costs data are transformed in gross euros per square meter for better comparison between the different costs and projects over the work stages. It is also easy to make comparison between the data and projects because the x-axis of each graph shows always the time of the project.

3.2 Results of project case studies

3.2.1 Case 1: Vantaa, a seven-storey block of flats

The graphs of case 1 show detailed information about the factors studied for case 1, as well as the safety performance and main work stages of the project. The information is transcribed graphically and explained below.

As seen in figure 7, the monitoring of work safety measurements has not been complete. Generally, the dustiness performance is at the same level as the total safety measurement. This could mean that dustiness is not a problem or not considered to be a problem. The level of dustiness falls before and after the closure of the building site. Waste management is at a higher level when the interior construction starts and later when the interior and yard construction is completed. Waste management falls when there are more activities going on, at the same time ends before the handover.

The graphic Cleaning and clearing costs during construction in the figure 7 shows two peaks of cleaning activities. The first one is when interior construction starts and the other just before final cleaning starts. They coincide with both drops in waste management. The cleaning peaks are characterised by two different types of cleaning tasks: clearing and façade cleaning. Between the two peaks, there is a decline, after the site closure. All through the project, cleaning costs includes also own work costs. The material cost is close to zero. It means that there has been no investment in equipment that supports cleaning efficiency.

In the graphic Final cleaning costs in the figure 7, the first final cleaning stage is the costliest. In this stage, all kind of marks are removed, windows are cleaned. The first part of the cleaning is done at the same time and the second part is done the following month. After this, small costs appear for corrections. Two subcontractors have been participating in final cleaning task, one in the task itself and another in task corrections.

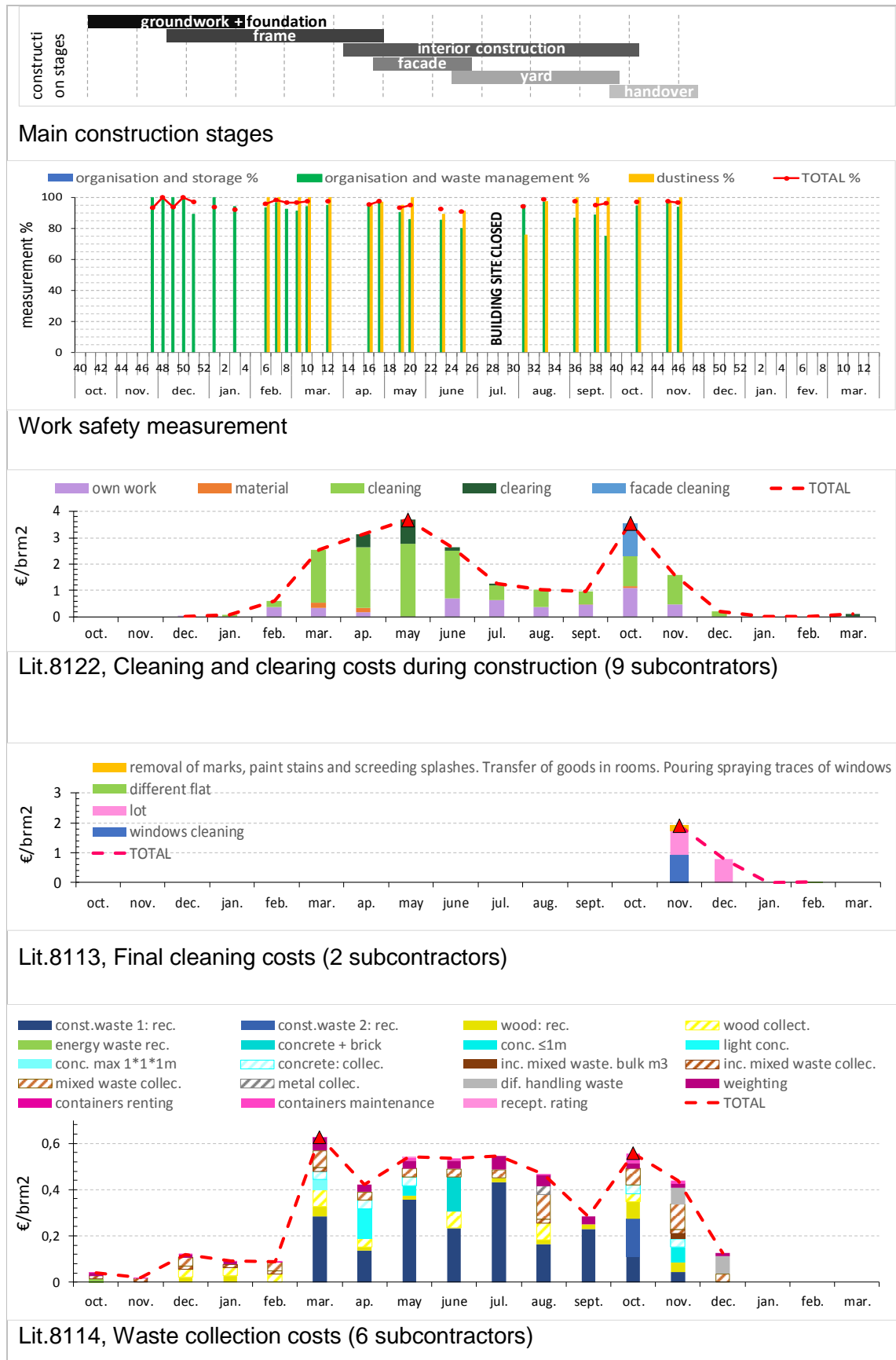


Figure 7. Case 1, Metrics

In the graphic Waste collection costs in the figure 7, the biggest waste cost type is the construction waste, from the completion of the framework construction to the delivery of the project. At the end of the interior construction of the seven-storey block of flats, construction waste class 2 represented a third of the waste costs of the month. The costs of various concrete waste start accumulating when the frame construction is completed, and the interior construction begins. The frame construction lasts halfway through the interior construction, and starts again when the interior construction ends. Concrete waste management is not steady because expectation could be that those costs arise during the frame construction. Each category of concrete waste is handled separately. Also, waste construction costs start at halfway of the frame construction and has a high peak. This can be interpreted so that there is no anticipation in waste management. The number of subcontractors is high so there is not a precise waste management plan developed by the waste management company.

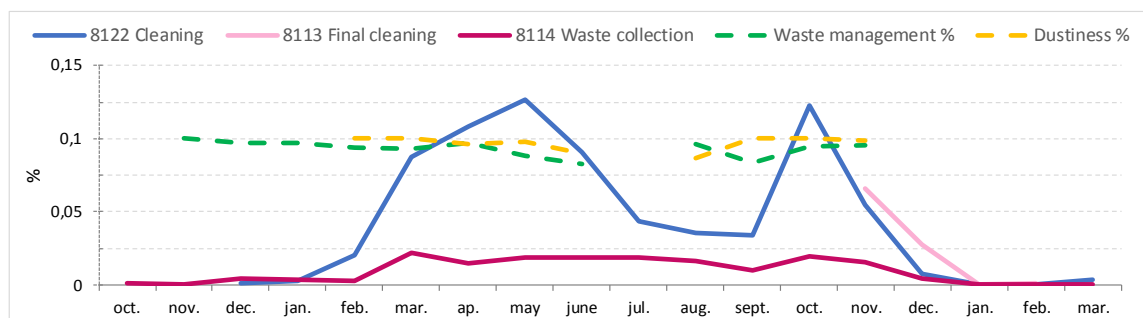


Figure 8. Combination of cleaning and waste collection costs, and waste management and dustiness performance measurement, Case 1

Figure 8 shows all the studied factors, the waste management and the dustiness in a single figure. The percentage of the costs of the total of waste collection, cleaning and final cleaning is calculated according to the total sum of those costs. There are two peaks in the cleaning costs, at the beginning and at the end of the construction project. The cost curve for waste collection is stable and low. Nevertheless, there are two small peaks at the beginning and at the end of the project, at the same times as the peak in the cleaning. The peaks in cleaning costs are four times higher than the peaks in the waste collection costs. Final cleaning costs form a decreasing segment. They start after the peaks in the cleaning and waste collection costs. The initial level of final cleaning costs, the highest, is two times lower than the cleaning peaks and two times higher than the waste collection peaks. The low level of the costs curves lasts for a long time at the

beginning and the end of the project with a level near zero. This time duration is equivalent to half the duration of the project.

3.2.2 Case 2: Vantaa, a loft-type seven-storey block of flats

The graphics of case 2 show detailed information about the factors studied for case 2, as well as the safety performance and main work stages of the project. The information is transcribed graphically and explained below.

The graphic Work safety measurements in figure 9 presents the few work safety measurements. The dustiness measurement was not taken often, and when amount of dust was measured, it reached the maximum level. This proves a lack of interest in this data in the project. The waste management measurement percentage is lower than the total work safety measurement. This means that if this data would be regularly measured, waste management would represent a bigger work safety issue.

The graphic Cleaning and clearing costs during construction in figure 9 shows the cleaning costs. At the beginning of the project, the cleaning cost curve rises. When there is the highest quantity of construction stages, the curve soars and reaches two peaks one after another. At the same time, a new cost, the cleaning costs for containers appear on the chart. All through the project, own construction work costs increase. The smallest cleaning cost is the cost of the material. Even the cleaning cost for containers is more important.

The graphic Final cleaning costs in figure 9 shows that the deficiency compensation for final cleaning lasts longer than the final cleaning itself. Nevertheless, its value is near zero. The cleaning of common spaces and re-cleaning mark the end of final cleaning tasks, and make a peak. Different tasks are well divided according to the different types of surfaces and spaces, such as windows, flats, bathrooms, and common spaces.

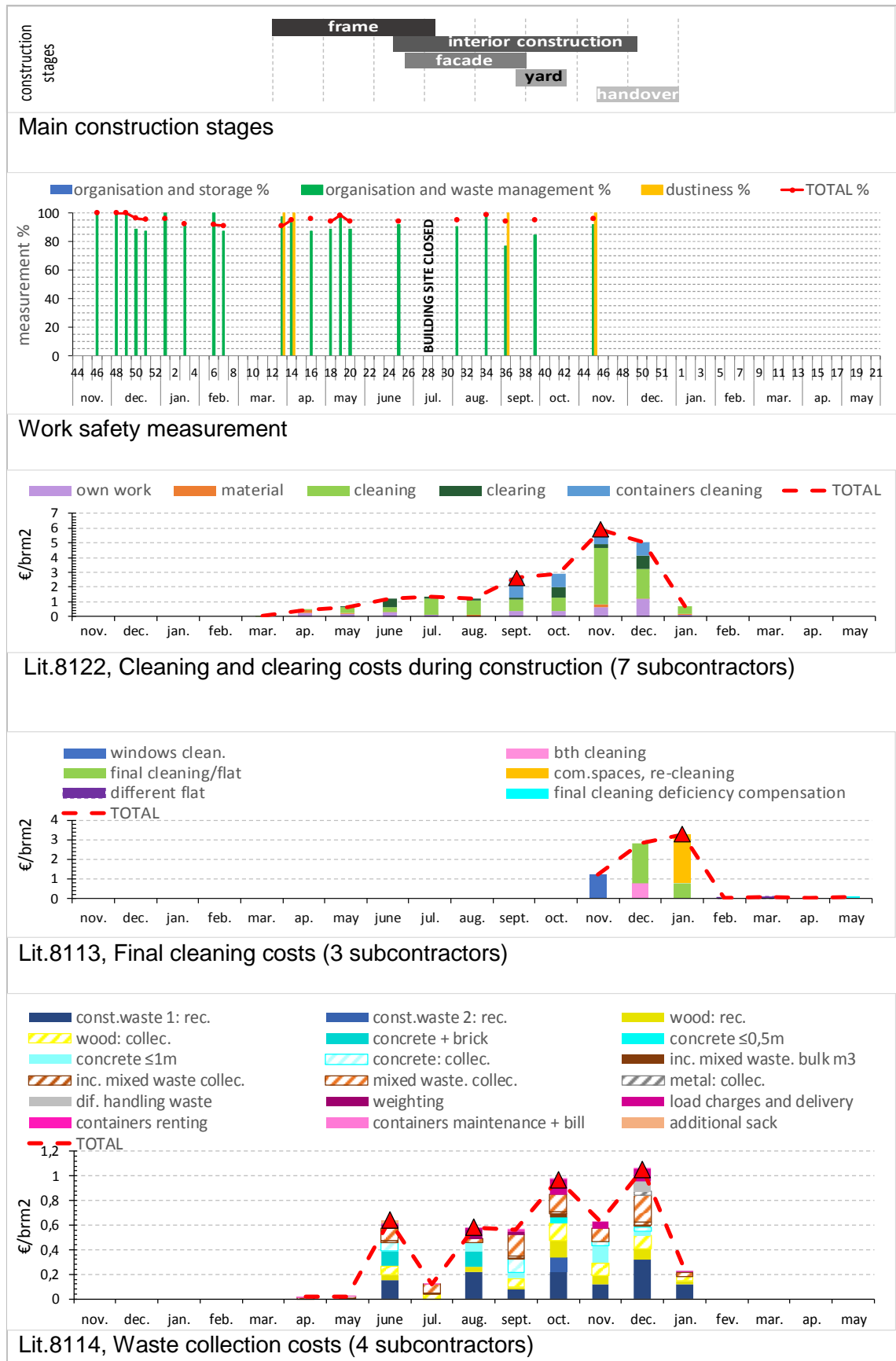


Figure 9. Case 2, Metrics

The graphic Waste collection costs in figure 9 bring focus on unstable waste collection costs, but it also shows that the amount of the different waste costs is balanced each month. There are many peaks with the highest at the end. It indicates that waste management is not planned for and that there is no maintenance. Construction waste class-2 is also present at the halfway of interior construction. This can be avoided by sorting the waste more carefully.

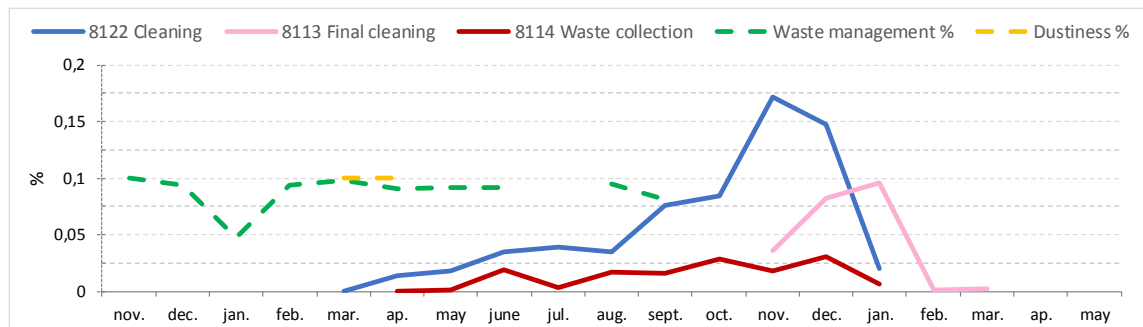


Figure 10. Combination of cleaning and waste collection costs, and waste management and dustiness performance measurement, Case 2

Figure 10 emphasises an inconsistency between waste management and dustiness measurement, and the cleaning and waste collection costs. They do not concur. The safety measurement curves stop when the cleaning costs increase. Furthermore, the cleaning costs when the final cleaning costs begin. The peak of the cleaning costs is one and half times higher than the peak of the final cleaning costs.

3.2.3 Case 3: Espoo, a six-storey block of flats

The graphics of case 3 show detailed information about the factors studied for case 3, as well as the safety performance and main work stages of the project. The information is transcribed graphically and explained below.

The data available are limited because the project is to be delivered in December 2018, after this thesis is completed. Yet the case adds a value to the research because I am part of the project as a site engineer. Thus, the approach and experience here are more practical.

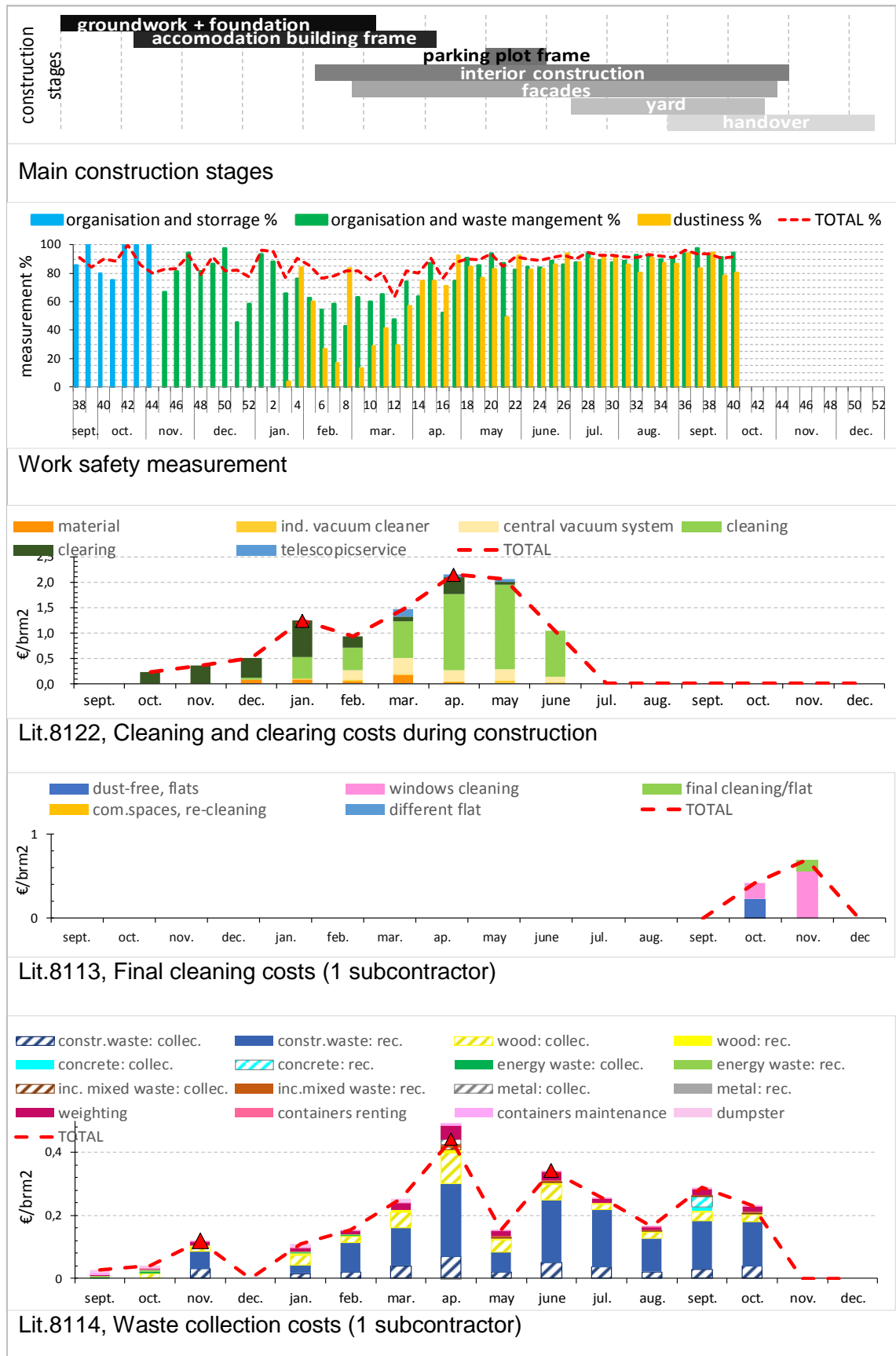


Figure 11. Case 3 (in progress), Metrics

The graphic Work safety measurement in figure 11 shows that the total work safety measurement percentage is higher than waste management, and dustiness measurement percentage. It means that waste management and dustiness are the biggest safety problem. The dustiness measurement performance is lower than waste management measurement performance, but it increases when the accommodation building frame is complete. When the number of construction stages is at its highest, the safety level diminishes. Also, when a new construction stage is starting, the waste management and dustiness measurements level decrease. The graphic shows a precise measurement of the safety at work. During the groundwork, foundation construction and frame construction for accommodation building, the curves are unstable. After, they reach a plateau.

In December, during the frame construction for accommodation building, the waste management level falls. Directly after it, in January, the cleaning and clearing costs peak as can be seen in graphic Cleaning and clearing costs during construction in figure 11. Then the interior construction stage starts in February and the waste management level falls again. In March, directly after it, the cleaning and clearing costs peak. A central vacuum system is installed once the building is weather-proofed. However, it should be used. When it is used, it is a small part of the cleaning and clearing costs.

The final cleaning stage of the project will start in October 2018 so the graphic Final cleaning costs in figure 11 is based on an installment plan. Payments are defined according the plan. The installment plan is plotted using a list of final cleaning tasks for each type of space. The description of the final cleaning tasks which are part of the global price is important because an hourly price is used for what is not listed. The observations showed that all documents, such as care, use, and installation instructions for the furniture, equipment and surface materials, except domestic appliances are thrown in the trash. In accommodation construction projects, each set of care, use and installation instructions for furniture, equipment and surface materials is given to the client. The dossier is called a resident folder. It reduces trash and saves working time if, during construction, they would be set aside in each flat. They would then be checked and organized as a resident folder for the handover.

Graphic Waste collection costs in figure 11 shows that waste collection costs increase at the same as the cleaning and clearing costs and when the quantity of construction stages is at its highest. In December, waste management measurements level and all

the costs are low, and waste collection costs are zero-valued. Immediately after that, in January, there is a peak in the cleaning and clearing costs. When the frame of the apartment building is ready, the costs for wood waste and containers increase. The graphic shows that the main type of waste is construction waste class 1. Simultaneously, energy waste cost is practically non-visible. In other words, it means that wastes are not so much sorted for this project. The cost for the collection of construction waste is low compared to the cost of recycling. On the other hand, the recycling cost of wood is high compared to its collection cost. Thus, it would be possible to minimize the cost of construction waste recycling by sorting it. In optimized waste sorting, the cost of waste recycling should represent a small part of the total costs of waste management.

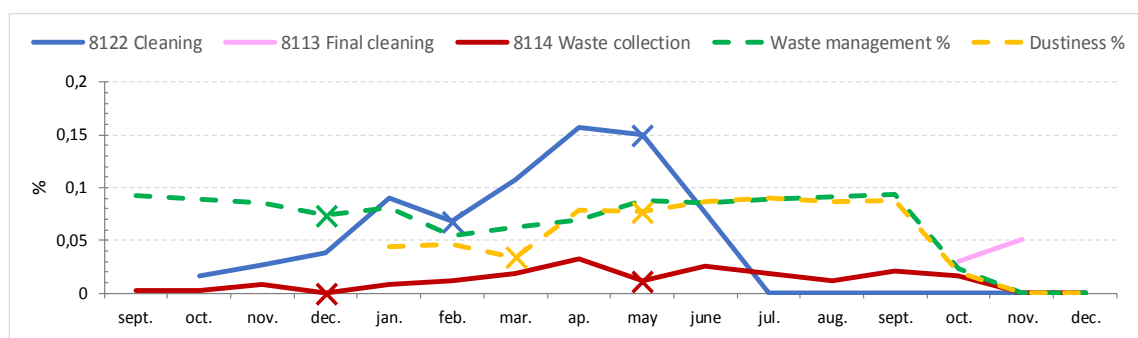


Figure 12. Combination of cleaning and waste collection costs, and waste management and dustiness performance measurement, Case 3 (in progress)

Figure 12 shows all the studied factors, the waste management and the dustiness in a single figure. The waste collection costs are much smaller than the cleaning costs. They peak at the same time, halfway through the project, in April, but the cleaning peak is five times higher than the waste collection peak. This occurs when there is a lot of simultaneous construction phases, but this starts after waste management and dustiness measurements fall. It is normal to have a peak in costs when there are lots of activities, but the costs could be lower if the waste management and dustiness measurements performance were more efficient.

3.2.4 Case 4: Kirkkonummi, a set of detached, terraced houses and a two-storey block of flats

The graphics of case 4 show detailed information about the factors studied for case 4, as well as the safety performance and main work stages of the project. The information is transcribed graphically and explained below.

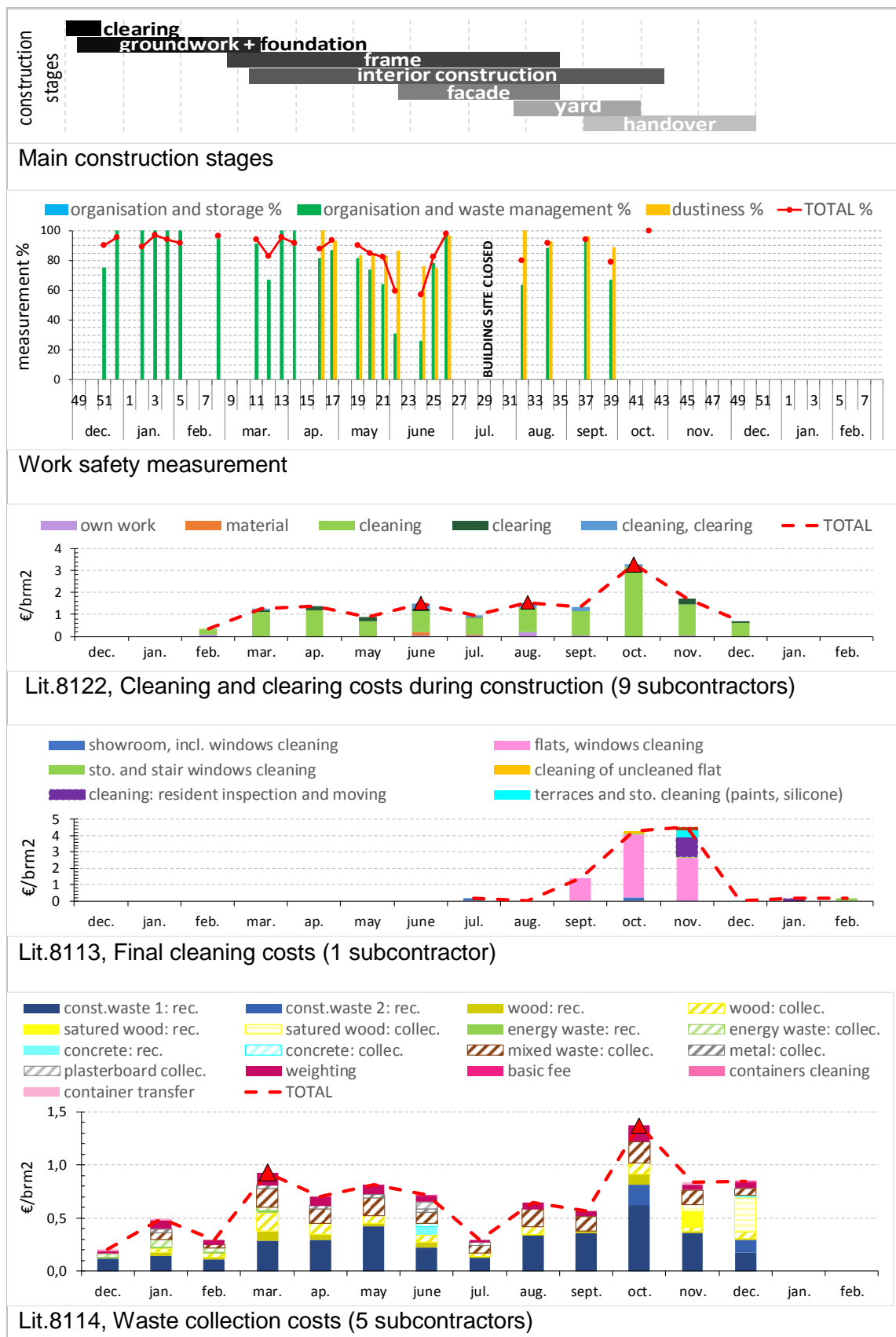


Figure 13. Case 4, Metrics

As presented in the graphic Work safety measurement in figure 13, the work safety data collection is not regular. From a general point of view, dustiness measurements percentage has a higher level than waste management measurements percentage, but in a proportional way. Waste management performance is lower than the total safety measurement performance. When the quantity of construction stages is at its highest, the safety performance diminishes.

When the interior construction stage is accomplished, as seen in the graphic Cleaning and clearing costs during construction in figure 13, the cleaning costs peak. This indicates that cleaning is not done gradually but only at the end of the work stage. Also, this peak appears after a period of missing work safety measurements. It seems that dustiness rules have been abandoned at this period of the construction. The cleaning work has been done by nine subcontractors during the construction. It had an impact on the regularity of the work, as well as its coordination.

The graphic Final cleaning costs in figure 13 illustrates the proportional importance of the various final cleaning tasks or costs. The cleaning of flats and windows are in the same group, the biggest one. Final cleaning is done under a period of three months. Thus, it means that it represents both phases of final cleaning, before and after ventilation tests. Cost and tasks control could be improved through a distinction of different types of work. Cleaning for resident inspection and moving represents one-third of the final cleaning costs of a month. It is a significant amount. The showroom apartment is treated in a special way. Therefore, it is important to mention it in the global costs of the contract to avoid it becoming an extra cost. The cleaning costs for technical spaces are small.

The graphic Waste collection costs in figure 13 shows the fluctuations of the waste costs. There are two main peaks when the interior construction starts and another when it ends. Between the two peaks, the costs get lower. It looks as if waste handling is only begun once the work stage is completed. This shows a lack of maintenance in waste management. Almost half of the monthly waste costs arise from construction waste class 1. Only when interior construction is completed and then handover starts, there is construction waste class 2.

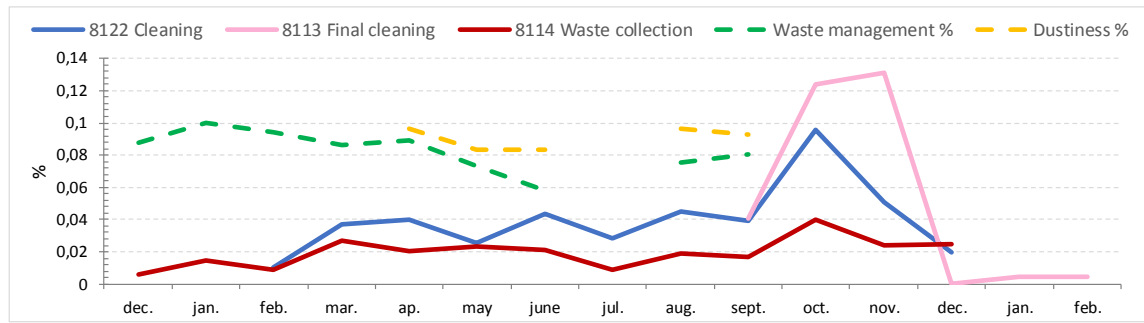


Figure 14. Combination of cleaning and waste collection costs, and waste management and dustiness performance measurement, Case 4

Figure 14 shows all the studied factors, the waste management and the dustiness in a single figure. The peak of final cleaning is one and half time higher than the cleaning peak which is two and half times higher than the waste collection peak. The peaks occur at the same time, at the end of the project, when the interior construction is completed. Moreover, measuring of safety ends when cleaning peaks begin. This circumstance could seem as uncontrolled factors of the project. Generally, the cleaning costs curve follow the waste collection costs curve but two times lower. The all costs and safety measurements curves are unstable all along the project.

3.3 Comparison of the cases and subjects of the study

The cost curves for cleaning and clearing, final cleaning and waste collection are compared by type and according to operating and total project costs.

3.3.1 Cleanliness

Figure 15 expresses monthly cleanliness costs of each case. Three of the curves have a single peak, two of them at the end of the project, and one of them is twice as high as the other. When discussing regular cleaning, the ideal would be one peak in the middle of the construction time, at the moment of the most numerous work activities.

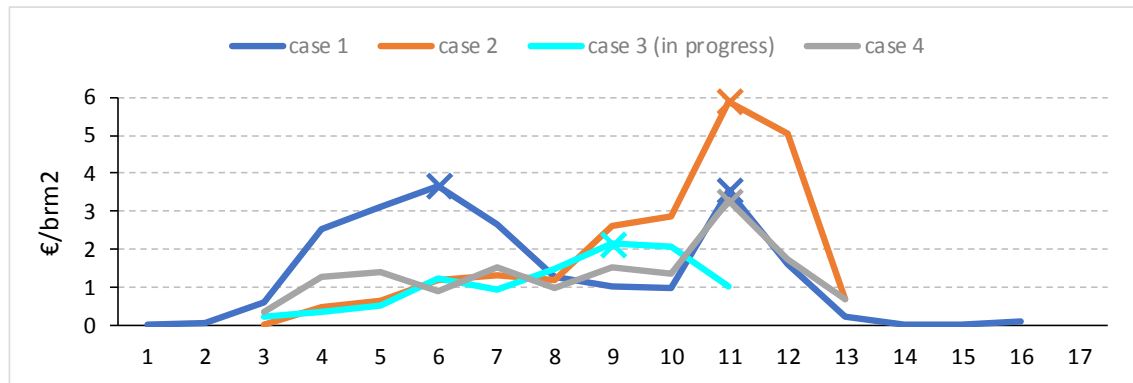


Figure 15. Lit.8122, Cleaning and clearing costs, project comparison

Figure 16 shows the monthly final cleaning costs of all cases. Case 3 is missing because the data are still not available.

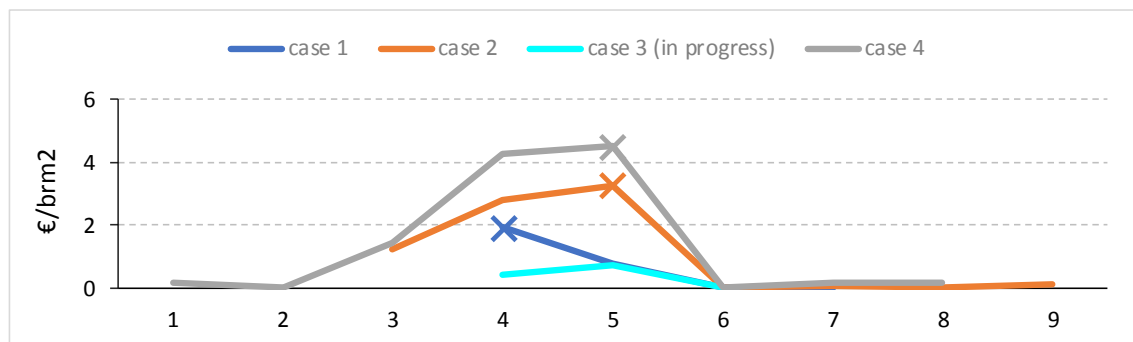


Figure 16. Lit.8113, Final cleaning costs, project comparison

The comparison highlights the difference in the organisation of final cleaning costs between the projects. Two are represented by a curve, one by a decreasing segment. The curves have a longer duration than the segment and their peak is twice as high. During the main activities of final cleaning, the curves are also twice as long as the segment. In addition, the finishing of the final cleaning lasts again twice as long for cases 2 and 4.

3.3.2 Waste collection

Figure 17 shows the levels and evolution of waste collection costs along the project. In case 1, the costs increase at the beginning of the project and then remain steady before a drop at the end. Project 2 and 4 with the highest level of waste costs are completely unstable.

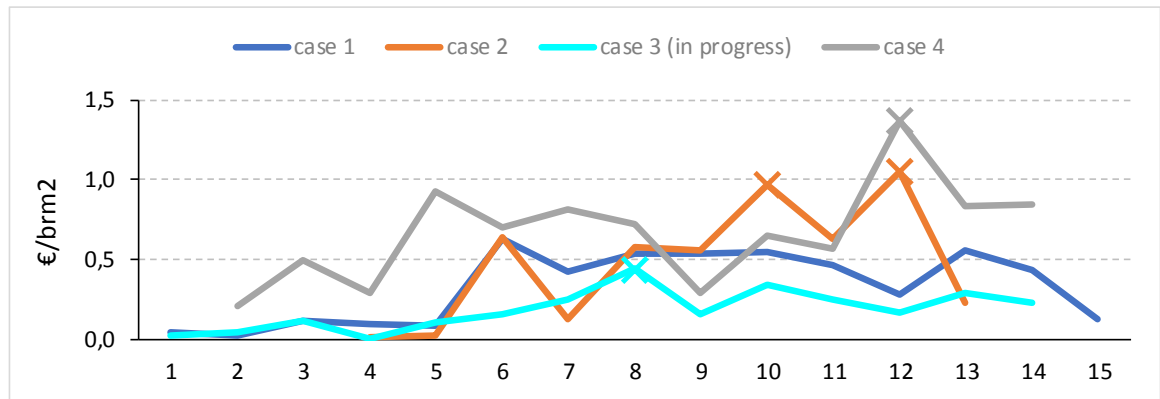


Figure 17. Lit.8114, Waste collection costs, project comparison

As shown in figure 18, case 2 and 4 also have the biggest amount of waste by volume of the project. The peak of project 4 is higher than any of the peaks of project 2. About costs, project 3 has the lowest level with a peak in the middle of the project. Case 3 has the most expected curve because its waste collection organisation is better, and the peak of waste collection appears at the same time of the biggest construction activity.

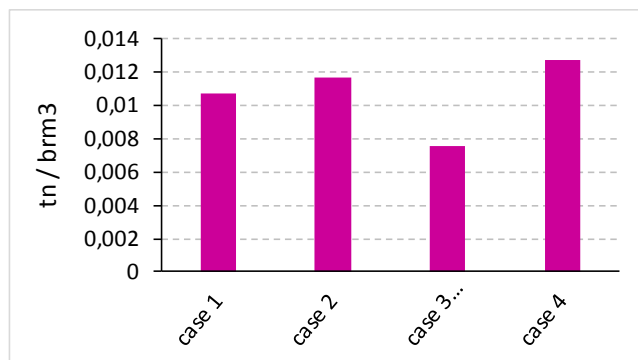


Figure 18. Total waste quantity, project comparison

When it comes to waste quantity (figure 19) case 3 shows the highest peak but smallest overall waste quantity. It could mean that unit prices are lower and/or sorting is better handled. Yet, case 3 is the only one which does not have construction waste class 2, in other words over 70% of its construction are recoverable.

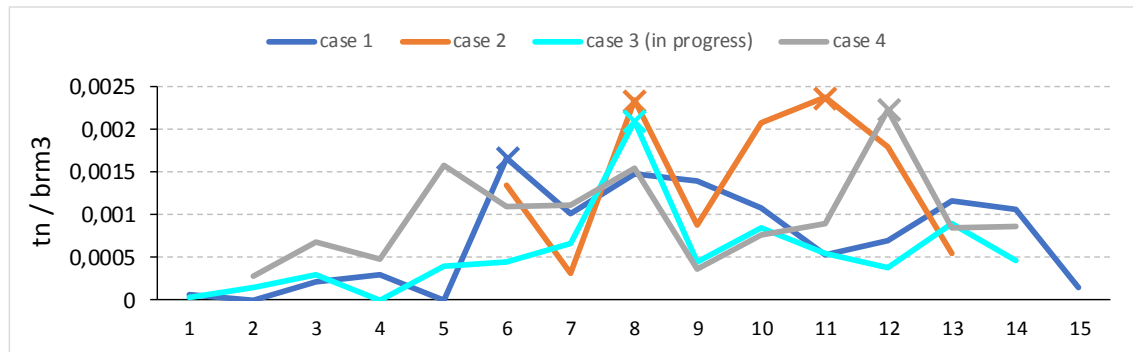


Figure 19. Waste quantity, project comparison

Figure 20 shows how the waste costs are divided by type of waste in each case. Container cost is quite similar in all cases from a proportional point of view, between ten and twelve percent. The costs in case 2 are fairly balanced between the different types of waste, each type ranges between seventeen and twenty-seven percent. This is very different from case 4. In case 2 the waste is sorted, in case 4 not. In cases 1, 3 and 4, construction waste represents between 44 and 64% of the total waste. Sorted wood, concrete, and mixed waste vary between 13 and 19% of the total waste. The other wastes, such as saturated wood, metal, plasterboard or energy waste are lower than 6% of the total waste.

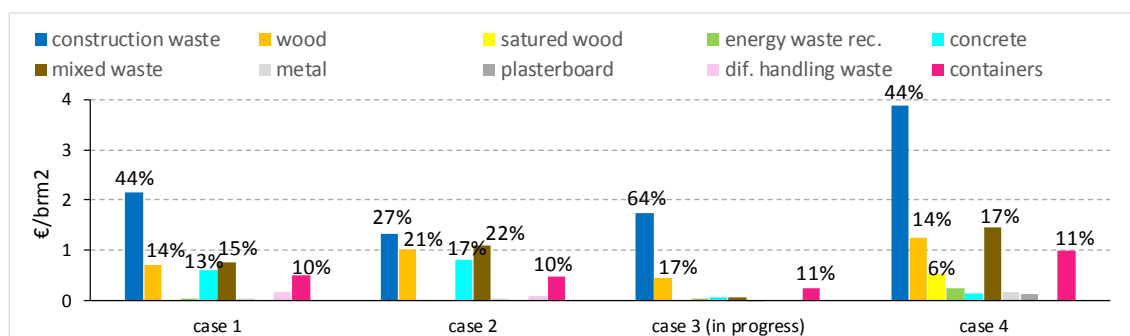


Figure 20. Waste costs by type, project comparison

The comparisons above enhance the observations done for the curves showing peaks and evolution of the cleaning and waste management costs for each case. Projects 2 and 4 show the highest curves and reveal similar symptoms. Both have high cleaning cost peaks at the end of the project, unstable waste collection costs with a higher peak at the end of the project, the biggest waste quantity and a long period of final cleaning

costs. In sum, it is useful to anticipate extra costs as well as cleanliness and waste management problems in order to minimize irregularity and unexpected happenings in their organisation.

3.3.3 Cleanliness and waste management according to operating and total costs

Total costs of the project organized in litteras 0 to 9 contain building site costs as well as costs for land, design, and marketing. The building site costs organized in litteras 1 to 9 are part of total project cost and contain the operating costs. Operating costs organized in littera 8 are part of both total costs of the project and building site costs. The more efficiently the company's operating costs are used, the more profitable the company. To think that a company is more profitable if its operating costs are the smallest is minimalist. The operating costs affect the core operations of the business. It is why they are the key to running a business and they must be adapted to the needs of the project. In the construction business, cleaning, final cleaning, and waste collection costs are part of the operating costs.

Below, the total costs of the project, the building site costs and the operating costs are represented for each project with two units, euros by area and percentage of the total and operating costs. These points out two types of comparison so by cost alone and by the value of the cost in a bigger picture.

The study showed that the biggest project in terms of surface built and number of staircases (case 3) has the lowest building site and operating costs. The project with the lowest building level and biggest ground area (case 4) has the highest building site and operating costs.

As shown in figure 21, operating costs are a significant part of the total project (litteras 0 to 9) and site costs (litteras 1 to 9). The average operating costs to building site costs proportion of the studied cases is 12%, and the average operating costs to the total project costs the proportion is 7,5%. The smallest proportion of operating costs to the total project and building site costs are achieved in case 4 with the lowest building level and biggest ground area. The biggest proportion of operating costs to the total project costs are shown in case 3, the project with the biggest built surface. Case 2, the loft project, showed the highest proportion of operating costs to the building site costs.

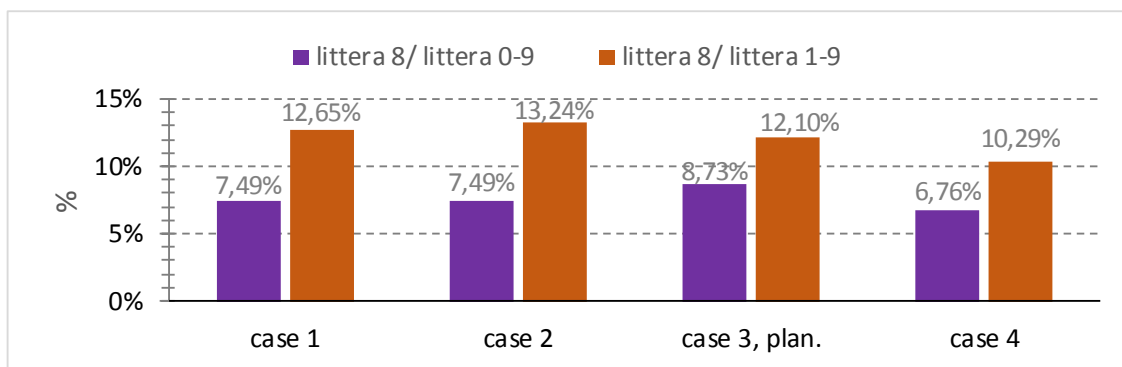


Figure 21. Proportion of operating costs to the site and total project costs, project comparison

Cleaning, final cleaning, and waste collection costs are a small part of the total project and building site costs, but they are an influential part of operating costs. Figure 22 illustrates the percentages in the four cases. The highest was 20% and the lowest 17%. In each case, the most important part of these costs' categories are the cleaning costs because they represent between 8 and 13% of the operating costs.

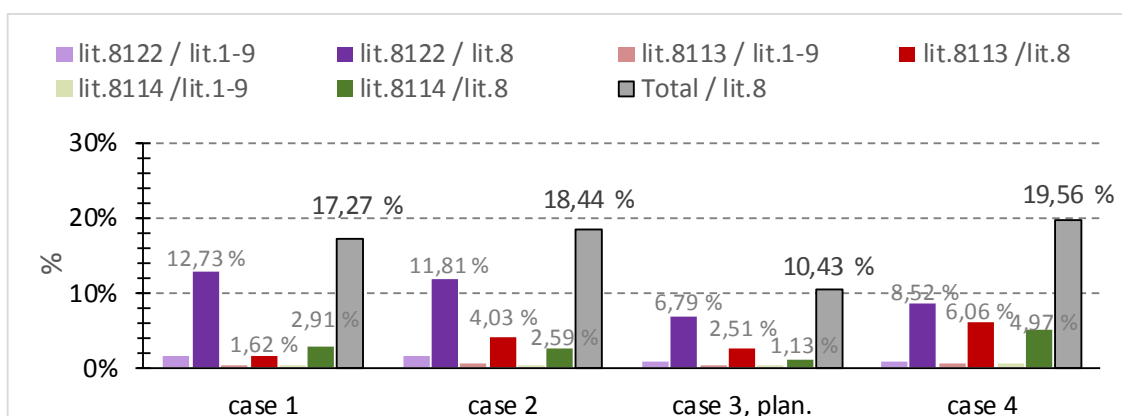


Figure 22. Proportion of cleaning, final cleaning and waste collection to the project and operating costs, project comparison

It was shown that the total costs for cleaning, final cleaning and waste management in cases 1, 2 and 4 were about the double of case 3.

Expected and realized costs are also an indicator of the success of cleaning, final cleaning, and waste collection management. There is no target costs data available for case 2, and all costs for case 3 are still not realised yet. Nevertheless, cleaning and clearing costs of case 3 are already almost equal to other cases. It can be expected that the real costs will be higher than the expected costs. Cases 1 and 4 have also more expensive

realized cleaning and clearing costs than their target. In case 1, the cleaning costs are three times the expected. It is a notable difference. The realised final cleaning and waste costs for case 1 are almost equal to the targeted costs or lower. The realized costs of case 4 are all the way through somewhat higher than the objectives.

The proportion of the operating costs to the building site costs is similar for each project, and the proportion of cleaning, final cleaning, and waste collection costs to the operating costs is different for each project. Indeed, the costs themselves are also disparate. The difference is more visible in unit prices than in percentages. These differences show that building site cleanliness and waste are managed differently for each case. The project type can also affect the management. The proportion of operational costs to the project costs is the highest in case 3, but the proportion of cleaning, final cleaning, and waste collection costs to operating costs is the lowest. The cleaning and waste costs in case 3 were handled in a more efficient way than in the other projects. Generally, the costs of cleaning and clearing are more critical than the costs of final cleaning and waste management as they last all through the project and they are the costliest of the three. Furthermore, the difference between the target costs and realised costs is the biggest in cleaning and clearing.

4 Guidelines for construction site cleanliness and waste management

4.1 Needs of EKE-Rakennus Oy

The following definition of the company's needs and set of guidelines for cleanliness and waste management is a result of this study and a discussion with a work manager representative of the firm. Generally, the company wants to base its needs on prevention aspects.

Firstly, the results from the monitoring tools such as work safety measurement and costs evolution must be considered. Safety measurement and monitoring must be regular. It is recommended that the safety criteria are measured by the same person to have consistent results. It is also necessary to multiply the number of observations to get a fairer result. The more the construction evolves, the more the number of observations increases. About two hundred observations or more could be expected. It requires the

sole use of a digital tool, no paper forms can be used. The tool can be Site Manager because it is already partly used by EKE-Rakennus Oy. Therefore, its integration is easy. The safety measurement results expected are between 90 and 100%, from the beginning to the end of the construction. A guide called safety on building site gives more information about how to execute the measurement. As an example, organisation and waste management performance is measured from the beginning of construction, while the dustiness performance measurement which starts when the building is weather-proofed.

The difference in cleanliness and waste management treatment between the various construction stages (the exterior and framework, and the interior) must be characterized with the presentation of different monitoring, tools, equipment, protection used and organisation. Furthermore, these main stages of construction are done by different sub-contractors. Hence, it is easier to inform them about what they are involved in. The exterior construction stage includes groundwork and foundation, structure, façade, and yard work. The interior construction stage includes all the interior construction tasks and handover. A common task for the interior and exterior construction stages is the plumbing, heating, ventilation, and air-conditioned work. Although, this common task causes most of modifications and errors on the construction site which generate waste, dust and dust propagation.

EKE-Rakennus Oy mainly build residential buildings. In residential construction, guideline required cleanliness class P2 is maintained. In cleanliness class P1, the documentation is too heavy. If a project requires the cleanliness class P1, it is considered separately. However, some criteria of the cleanliness class P1 are also selected to be part of the guideline for EKE-Rakennus Oy based on cleanliness prevention in order to minimize maintenance cleaning. These criteria are listed in the following text. A central vacuum system with a Hepa filter is used when the structure is closed, at the same time as the dustiness measurement starts. At this point, no sweepers or brushes must be used to avoid dust spreading. Due to the physical characteristics of block of flats projects, spaces are already partitioned from the installation stage of prefabricated elements. Nevertheless, entrance doors of each flat are only mounted at the end of interior construction stage. It means that each floor, except for the parking area is already divided and separated in smaller areas but not completely closed because the entrance doors are missing during construction. Some rooms are already used as closed storage areas, but it would be easy to close evens apartment to avoid dust propagation. When dusty interior tasks are done, the flat or area concerned can be completely closed with temporary doors.

Respiratory protection with the correct filter is used according to the type of work and dust. Compartmentation and under pressure system are not used in the projects of EKE-Rakennus Oy because of a lack of space due to the type of projects. Generally, LVI equipment and false-ceilings are protected from dust. Dusty works are done with a machine or tool equipped with an integrated dust collector and correct dust filter. The obligation to use this equipment is not mentioned in the general subcontracting guidelines of EKE-Rakennus Oy, but it could be added and discussed in the negotiations or preliminary meeting. Also, each subcontractor should have the responsibility of cleaning his own work area and directly after a dusty task. This way, the cleaning tasks of EKE-Rakennus Oy would be mainly maintenance.

Cleaning costs during construction represent an important part of the operational costs. Furthermore, they are the costs that show the biggest difference between costs target and realization. The four cases studied in this thesis show that the real cleaning costs vary between 1 and 6 €/brm² per month per project, when the project area is between 3200 and 5300 brm². Furthermore, EKE-Rakennus Oy is engaged in several projects at the same time. It would be possible and efficient to organize a specific cleaning group to work on every project. An allocated budget for cleaning should be increased because they have been underestimated. On the other hand, cleaning must be more efficient due to more prevention and protection. Moreover, the indirect costs should be taken into account to have the real cleaning costs, as mentioned in chapter 2.1.5.

Final cleaning guidelines should present clearly the different types of tasks for the two main final cleaning phases with one before operating tests and the second after. Therefore, dust cleaning is realized before the tests because no dusty tasks cannot be executed after them. After dust cleaning, during self-delivery, dust concentration cannot be over 2,5 g/m² on the inner surfaces of the ventilation equipment. The purity assessment is done visually. Final cleaning tasks depend on handover planning.

Final cleaning tasks must be differentiated according to the category of spaces, either residential and common areas. Residential areas are private flats with a bathroom, kitchen, and living area. Common areas include circulation spaces (staircase and elevator), common living spaces (sauna and clubroom), technical spaces, storage spaces, and parking plot. The reason for defining the different spaces precisely is that they have their own characteristics. [29.] Furthermore, the better the area and tasks are defined precisely, the less there are extra tasks that are unplanned for in the target costs.

The four cases studied in this thesis show that the final cleaning costs vary between almost 0 and 4,3 €/brm² per month in projects with an area between 3200 and 5300 brm². The work should last for about two months and be extended to include correction cleaning just before the residents move in. This specific final cleaning must not be mixed with cleaning and clearing during construction. Cleaning during the construction ends when starts the first stage of final cleaning.

When it comes to waste, the purpose is to diminish it, not just its costs, but also its quantity. Yet, indirect waste costs and environmental issues depend on waste quantity. Sorting on each floor of the construction project means organising necessary space for wood, plastics, paper and board, mineral and ceramic, gypsum-based waste bins. Yet, in a block of flats project, the space available in the walkways areas is limited. In order to sort waste, everyone should get the sorting instruction. The quantity of waste collected must be minimized and optimized. It is easier to organize sorting bins for exterior construction because there is more space available. The sorting bins are for construction waste, wood, concrete, metal, and energy waste. Construction waste class 2 must be avoided because the new Europeans waste directives will remove it in 2020 [26.]. To avoid construction waste class 2 is a challenge for the company because this level of waste is created in almost every project. Generally, mixed waste must be the last choice of sorting because a big part of mixed waste goes to the landfill. When waste is sorted, it is reused or recycled. Some waste has a specific recycling or reusing process run by a specific company, as for example plasterboard waste, concrete, and brick waste and extra material. Each chemical product which becomes hazardous waste is clearly listed on the building site, and its waste is collected separately. To achieve best possible waste management, it could be also wise to consider the office part of the construction site. The main waste produced by an office is paper, plastic, and biowaste. The purpose of sorting the waste of the office is to minimize the mixed waste.

The amount of material loss could be minimized by delegating the task of ordering materials to subcontractors. It means that the subcontractors for concrete, brick wall and interior construction would organise the construction task and the necessary materials themselves. It would mean that they take the cost risk of lost material, but also that if they do not order the material at the correct time, the project will be late.

Since more than 100 tons of waste is produced annually by various projects, the waste must be recorded for example according to type, weight, cost of processing and collecting, for example, each month. Having just one subcontractor handling waste management can facilitate this work. Nevertheless, it may be necessary to do the recording manually because there is more than one project in construction on a single same place, and so waste is handled for all projects in the whole place.

Waste cost is not an important part of operating costs, but it is literally a cost that goes to waste, and it also involves a lot of indirect costs. The general subcontracting guidelines of EKE-Rakennus Oy, it should be mentioned that each subcontractor sorts their own waste. Then the maintenance cleaning group can transport the sorted waste to the correct containers. Of course, the best choice for waste management is to reuse the waste as a material. This would minimize the amount of lost material. It is also important to keep in mind that the waste costs reported in the costs' analysis are only the collecting and processing costs, not the total costs. This makes a big difference in the waste costs. Waste costs calculation could be performed differently, as mentioned in chapter 2.2.3. The cases studied in the thesis show that waste costs vary between 0 and 1,4 €/brm² per month for project' areas between 3200 and 5300 brm². The amount of waste in then varies between 0 and 2,4 kg/brm³ per month for project volumes between 10 467 and 17 706 m³.

As demonstrated in this study, most safety performance problems and costs peaks occur due to a lack of anticipation, related to a lack of regularity, planning, and monitoring. Therefore, it is essential that the guideline developed in this thesis has a clear structure and process. Furthermore, to create a specific guideline, some practical points must be accurate. To minimize unexpected situations and extra costs caused by cleaning and waste management, maintenance is imperative.

The number of subcontractors per projects for cleaning and waste management should be lowered to facilitate the management and monitoring of these services. Some extra subcontractors should be used if they propose some special services needed for the project. However, this may be difficult siwe, the current economic situation of the construction is reaching its height. Thus, there are not many subcontractors and workers available when they would be needed.

This study puts forward the importance of managing cleanliness and waste as a whole. After all, their share can reach 20% of the operating costs. Case 3, the loft project which is the concept developed by the company has bigger cleanliness and waste costs than the normal block of flats projects. It is also high for detached and terraced houses project, but the company development policy excludes this type of project in the future.

The plan for construction site cleanliness and waste management at EKE-Rakennus Oy are presented in the appendices 1 and 2. The plans are based on documents from the company and have been developed during this study. The first part of the plan introduces the responsibilities of different actors of the project, the second part introduces the legislation, the third part covers the environment of the subjects studied, such as the waste collection point, material protection and information, and the cleaning rhythm. Part four in the plan describes the different work stages, rules, risks, and equipment specific features for cleanliness and waste management.

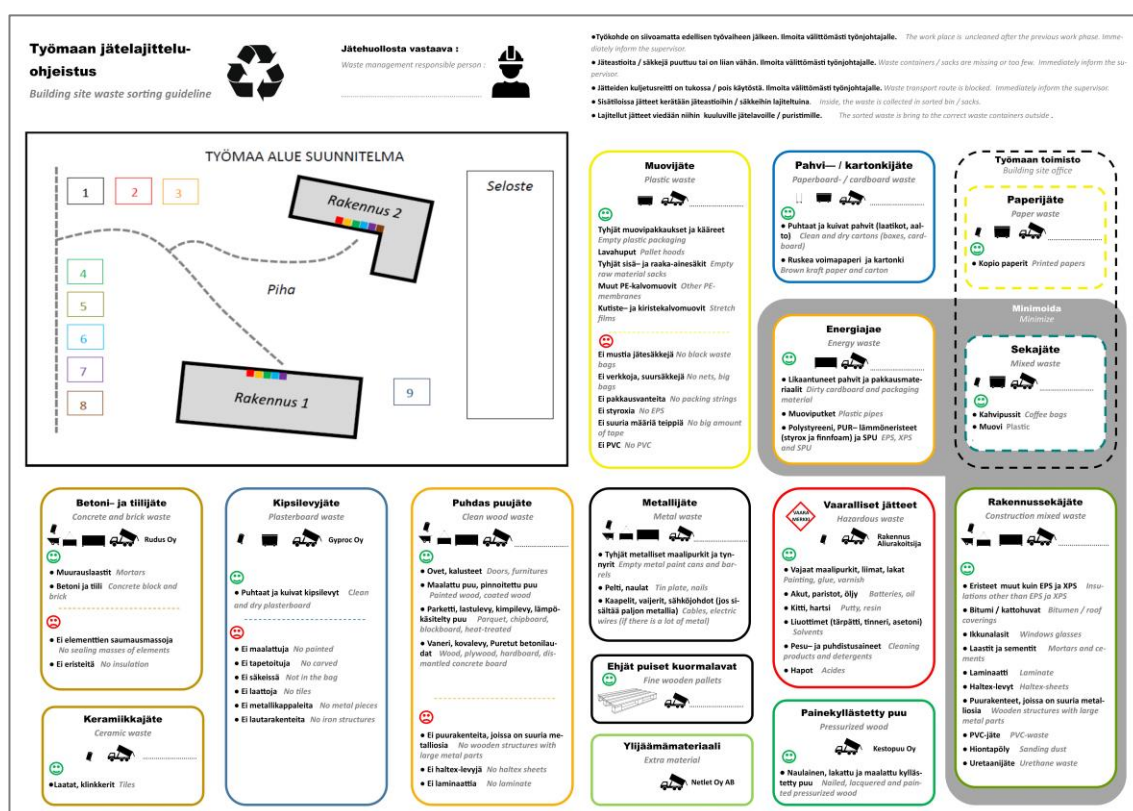



Figure 23. Building site waste sorting guideline per type of waste


The new waste guideline of EKE-Rakennus Oy presents waste sorting instructions as two sets of instruction according to the type of dust and according to the type of tasks.

The first set of instructions defines the type of containers, the specialized subcontractors who handle the waste process, the waste recovery or reuse rate and main guidance for waste sorting. The first set can be presented on-site as shown in figure 23. The second set of instructions defines how to process each type of dust at each task of construction. The cleanliness guideline is also presented from two viewpoints. Firstly, the different types of tools for dust prevention, protection, and removal is presented and then the process followed in each type of task is presented on-site as a set of instructions shown in figure 24.

Työmaan siivousohjeistus
Building site cleaning guideline




Siivoushuollosta vastaava :
Cleaning management responsible person :



• Työkohte on siivomatta edellisen työvaiheen jälkeen, ilmoita välittömästi työnjohtajalle. The work place is uncleaned after the previous work phase. Immediately inform the supervisor.
 • Jäteastioita / säkkejä puuttuu tai on liian vähän. Ilmoita välittömästi työnjohtajalle. Waste containers / sacks are missing or too few. Immediately inform the supervisor.
 • Jätteiden kuljetusreitit on tukossa / pois käytöstä. Ilmoita välittömästi työnjohtajalle. Waste transport route is blocked. Immediately inform the supervisor.

1 Pölyntorjunta
Dust prevention



Koneissa kohdepoistolaiteisto ja oikea suodatin.
Electrical machine / tool with integrated dust collector and correct dust filter.

Laastin valmistus **asuintilan ulkopuolella**.
Preparation of mortar **outside of the living area**.

Pölyivät alueet eristetään väliaikaisilla ovilla tiloista, joissa ei ole pölyäviä töitä.
Dusty areas are isolated by temporary doors from spaces where there is not dusty work.


ALUE ERISTETTY VOI KUKIDA TESTI, SULJE OVI.
Eristetty alue pidetään suljettuna. Huolehditaan ilmoituksista, kts- ohjeinen kuva. Isolated area is kept closed. Notification is given as in the picture next.

Työpasteen siivous tulee suorittaa **heti** pölyävän työvaiheen tai tehtävän jälkeen. Jokainen alluraakoitsija siivoaa oman työnsä jätet. Site cleaning is done **directly** after dusty work or task. Each subcontractor cleans it himself.

PÖLYTÖN ASUINLO, SULJE OVI.
Kun loppusiivous alkaa, pölyttömien asuntojen on oltava suljettuna. When final cleaning begins, keep the dust-free flats closed.

Tilojen säännöllinen siivoaminen :
ylläpitosiivous keskuspolymurilla, erityisesti yhteistiloissa = varasto tilat (1 / viikko) ja porrashuoneet (2 / viikko).
Regular cleaning : Maintenance cleaning, with central vacuum system, especially in common spaces = stockage areas (1 / week) and staircases (2 / week).

2 Pölysuojaus
Dust protection




Kun tehdään pölyäviä töitä, käytössä vähintään P2-luokan hengityssuojain.
When there is dusty work, construction workers use fine particle respiratory protection, at least protection class-2.

Sisävalmistusvaiheessa suojataan pintamateriaaleihin (ikkunat ja ovet, lattiat, portaat, hissit ja kalusteet) suojaukset: muovi ja / tai pahvi ja kartonki.
During interior work stage, protect the surface materials (windows and doors, floors, stairs, elevators and furniture) with plastic or paperboard and cardboard.

Suojataan LVI-putket ja -laitteet.
Protect HVAC pipes and devices.

3 Pölynpoisto
Dust removal



Harjaa ei saa käyttää.
Sweep can not be used.

Runkovaiheessa karkaa siivous tehdään lastaa käyttäen.
During frame stage, rough cleaning is done using a squeegee.

Tehdään ensin karkaa siivous ja sen jälkeen tilat imuroidaan.
Use first rough cleaning and then the vacuum cleaning.

Keskuspolymurin käyttö, kun sisävalmistustyöt alkavat.
Central vacuum system used when interior works start.

Kun ei ole mahdollista käyttää keskuspolymuria, käytetään teollisuuspolymuria.
When it is not possible to use the central vacuum system, use industrial vacuum cleaner.

Teollisuus- ja keskuspolymurissa on Hepa-suodatin.
Industrial and central vacuum system are equipped with Hepa-filter.

Töiden jälkeen, jokainen alluraakoitsija siivoaa työnsä keskuspolymurilla, jossa on Hepa-suodatin.
After work done, each subcontractor cleans his work area with the central vacuum system equipped with Hepa-filter.

Jäteastiat tyhjenetään heti, kun ne ovat täynnä.
Waste bins are emptied as soon as they are full.

Figure 24. Cleanliness guideline per type of tools

To summarize it, the waste sorting and cleaning process are defined according to the construction tasks. The dust prevention, protection, and removal process are explained for each type of dust and construction phase. The sorting process is explained for the different types of waste according to the construction stage. When presented on-site, it facilitates the instruction of each subcontractor. It can be presented on-site as in figure 25. The full guideline is in appendix 3.

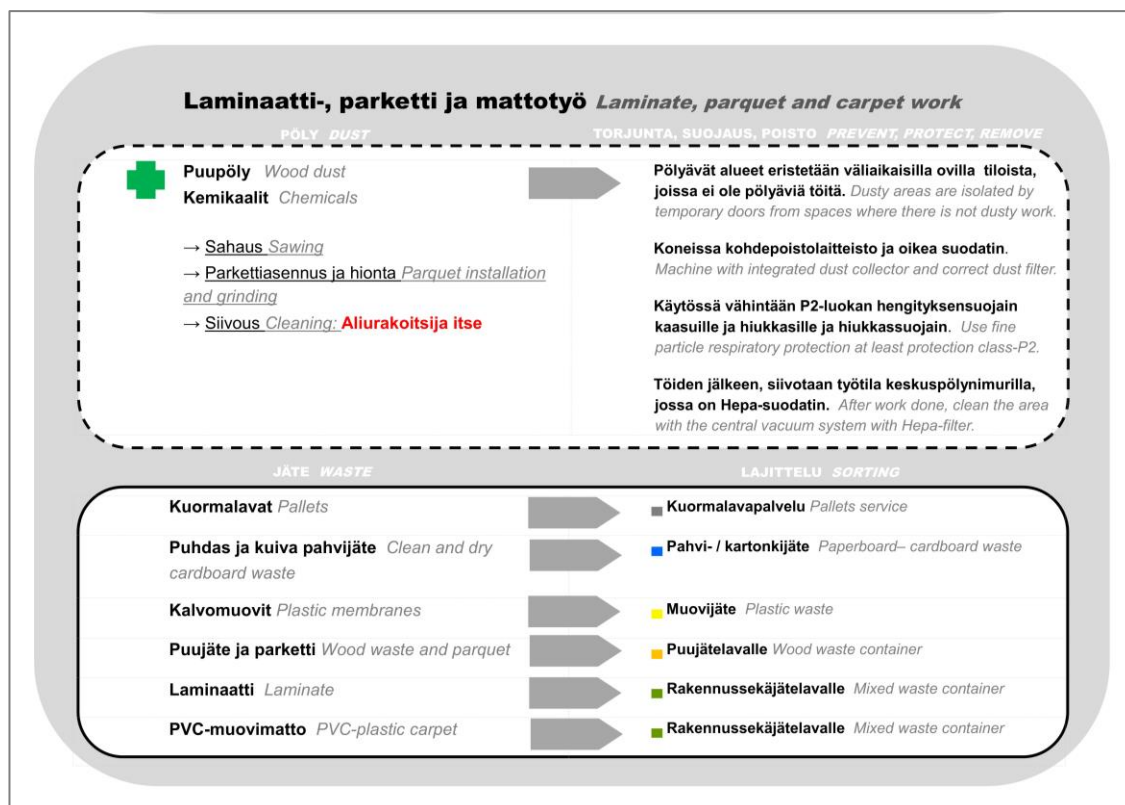


Figure 25. Waste sorting and cleaning guideline per construction work phases

Part five in the plan presents the estimation of quantity and costs, the sixth part presents the monitoring tools and results of quantity and costs.

The cleanliness management plan and waste management plan of EKE-Rakennus Oy follow the description presented in the chapters 2.1.5 and 2.2.3.

4.2 Implementing the guideline on-site

It is natural to prefer comfort and stability to changes, and employees also prefer to keep to old work habits instead of improving and modifying them. This is the main problem when integrating modifications in existing systems, and in the specific environment of construction.

The previous cleanliness plan and waste management plan were used as a basis for the current plan. This facilitates the new guideline development which includes the both subjects, as well as its incorporation into existing practice. Moreover, the new guideline is based on the current practice of the company, so it is adapted to the users' needs. The

organisation and use of the guideline must be intuitive to facilitate its application. Furthermore, the guideline must be visible on-site. It should be simple and easy to understand and to use. [30.] Pictures and different languages can be used in the guideline.

The first criterion for the implementation of a new construction site cleanliness and waste management guideline is its feasibility. Workers need to have the necessary resources to be able to apply the guideline. Those are materials such as monitoring devices, specific equipment and immaterial, such as time, knowledge and budget. The responsibilities and roles of each party must be defined. [30.]

The site manager, foremen, site engineer must believe in benefits of the guideline for the construction project itself, the workers, and the environment. Workers must be engaged in the implementation process and their feedback must be taken into consideration. The company should support change by organising different steps or education, or both. [30.]

The guideline must be easy to understand in other words the communication of the document has to be clear. Pictures, graphs, and diagrams are a good way to transmit ideas. Communication between different employees involved in the change is also essential. To support the importance of the topic for the company and for the workers themselves, the specific rules and tools for waste and dust management should be pointed out to them during their introduction to the site. Moreover, subcontractors should explain the rules of EKE-Rakennus Oy to their employees. Construction site foremen, site engineers, and site managers should understand that they are part of a group and that the implementation of the new rules and correct monitoring of the projects are not optional. [30.]

Companies change constantly because the market is alive and evolving continually. To continue using and improving this guideline, it is necessary to assess its benefits. They can be economical, social and environmental. Thanks to constant update, the guideline can always be adapted to the practical situation of the company concerned.

5 Conclusion

The collection, classification, and transformation of case study data was a laborious process. Some resulting figures are more explicit than others. However, even the non-explicit figures are still a symptom of something. All the graphics are inherent to the research because they show practical results. Also, their strength is that they are part of a whole. This research demonstrates a lack of correlation between projects site cleanliness and waste management approach and control.

Generally, dust is a fairly immaterial problem whereas waste is a problem discussed in tons. It seems that the regulation and implemented policies are proportional to this. It is important to keep in mind that less visible problems are not necessarily harmless. Dust is related to health issues whereas waste is related to environmental issues. Both affect the quality aspect of the project, without ignoring cost and time constraints. Additionally, exterior constraints such as regulation, evolve and become more and more demanding.

Cleaning and dust management interact through their indirect costs and tasks. A lack of cleaning can cause more dust, and a lack of waste management can cause more cleaning. As part of the operating system and cost, they affect the whole project process and success of the whole project. The idea of developing a guideline is that the effect of efficient cleanliness and waste management is exponential on the project.

In order to implement a new construction site cleanliness and waste management guideline, precise monitoring and underlying monitoring tools on the building site are essential. Monitoring tasks depend on the participation of the foremen who are depending on the order of the site manager. Foremen are also the key to implementing the guide on-site because they are the intermediate between the guide and the workers. Managers must communicate the guideline precisely. The purpose of using the guideline is that the operation of the building site team leads the achievements of cleaning and waste management process.

This study compares a lot of information: the generalities, regulation, organisation and tools for cleanliness and waste management, their costs in general and detail, the proportion of their costs to the total project, construction site and operating costs and the difference between target and real costs. Analysing every project as a whole provides

richer results than isolating the systems which make one project. Those similar projects are finally one project, the development of EKE-Rakennus Oy.

As shown in the thesis, precise cleanliness and waste management processes, tools, and research exist already. The main issue is to develop an adapted plan for a specific company and its field of construction and then to implement it concretely on a building site. The main question is more a matter of social habits and psychology than of construction itself. This main issue gives the general direction of future challenges for cleanliness and waste management in construction. Research and development cannot remain just words if a company wishes to engage in sustainable development during perpetual expansion and progress.

Thanks to ongoing effort, there is continuous improvement because negative impacts can be corrected, and positive impacts can be emphasized. Positive impacts can be seen practically on-site and virtually through precise monitoring and clear analysis of work results. Furthermore, recurring problems from all the project of the company can be pointed out and corrected on a bigger scale. Generally, a guideline must be living tool, following the current legislation and serving the needs of projects.

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EKE-Rakennus Oy, building site waste management plan

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Jätehuoltosuunnitelma: Uudisrakentaminen**Työmaan yleistiedot:**

Kohteen nimi:	As Oy xxxxxxxx,	Xxxx
Osoite:	XXXXX XXXXXX	xxx
Työnumero:		XXXX
Rakennustoimenpide ja tilavuus:		xx m ³
Rakennus aika:		vko xx/xx – xx/xx

Perustajaurakoitsija:	EKE- Rakennus Oy	Piispanportti 7 02240 ESPOO
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Projektipäällikkö:	Xxx	040 xxx xxxx
Vastaava mestari:	Xxx	040 xxx xxxx
Työnjohtaja:	Xxx	040 xxx xxxx
	Xxx	040 xxx xxxx
Työmaainsinööri:	Xxx	040 xxx xxxx

Jätehuoltourakoitsijan tiedot:

Yritys:	Xxx Oy		
Osoite:	xxx		
	xxx		
Yhteyshenkilö:	xxx	040 xxx xxxx	xxx@xxx
		tilaukset + tyhjennykset	010 xxx xxxx



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1 Jätteen synnyn ehkäisyn ja jätehuollon tehtävät vastuuhenkilöittäin

Työmaan ympäristövastaava:

- Laatii jätehuoltosuunnitelman yhteistyössä Xxx:n alueellisen yhteyshenkilön kanssa
- Vastaa jätehuollon koordinoinnista ja lajittelun järjestämisestä sekä aliurakoitsijoiden ohjeistamisesta jätehuoltosuunnitelman mukaisesti: Aliurakoitsija lajittelee oman jätteensä itse.
- Valvoo vaarallisten jätteiden oikeaoppista varastointia ja poiskuljetusta
- Valvoo jätetietojen raportointia

Työmaan logistiikasta vastaa:

- Pyrkii välttämään tavaroiden välivarastointia
- Suojaa materiaalit huolellisesti kosteudelta ja kolhuilta
- Tarkistaa työmaalle tulevat tuotteet ennen vastaanottokuittausta

Hankintainsinööri:

- Tilaa tuotteet oikea-aikaisesti
- Pyrkii käyttämään määrämittäisiä tuotteita ja elementtejä
- Minimoi hukkaprosentin tilattaessa

2 Rakennusjätteiden lajittelu ja kuljetus

Jätteet lajitellaan vähintään Pääkaupunkiseudun jätehuoltomääräysten mukaisesti sekä Valtioneuvoston päätös rakennusjätteistä (Vnp 295/1997) noudattaen.

Kaikki rakennusjätteet kuljetetaan viranomaisten hyväksymille vastaanottopaikoille. Keräilyvälineet merkitään opastein kerättävän jätelaadun mukaan. Jokaisen työntekijän ja aliurakoitsijan velvollisuuksiin kuuluu lajitella omat jätteensä ja toimittaa ne jätelavoille. Rakennusjätteiden kuljetuksessa noudatetaan viranomaismääräyksiä.

Jätelain etusijajärjestys on: (jätelain (Luku 2, 8§) ns. etusijajärjestys)

- 1. Vähentää jätettä / ehkäistä jätteen syntyä (parempi suunnittelu ja laskeminen: pienentä korjaukset, hukka ja suojaus)
- 2. Käyttää uudelleen
- 4. Kierrättää jäte materiaalina
- 3. Lajitella ja hyödyntää jäte energiana
- 5. Loppukäsittely = kaatopaikka (jäte voidaan sijoittaa vain, jos sen hyödyntäminen ei ole teknisesti tai taloudellisesti mahdollista)



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3 Jätteiden keräyspiste

Siisteyden ylläpitoa ja lajittelun selkeyteen auttaa, kun jäteastioihin merkitään selvästi, mille jätelajille astia on tarkoitettu. Lisäksi jäteastioiden välittömässä läheisyydessä ja taukutiloissa on hyvä olla yksinkertaiset ja selkeät lajittelu- ja täyttöohjeet (mm. pahvin litistäminen tilan säästämiseksi). Kuvalliset ohjeet helpottavat vieraskielisten rakentajien jätelajittelua. Jätekeräysvälineen tulee olla hyvässä kunnossa.

Rakennuksen joka kerroksessa porrashuoneessa, on lajittelupiste jätteille. Lajittelupisteen vieressä on jätehuoltosuunnitelma. Ulkona pyörällinen roskakärry ja jätteen nosto astia ovat käytössä. Kaikki jätteet tuodaan oikeille vaihtolavoille, kannelliseen jätetonttiin tai jätetunneleeseen.

→ Työmaan jätteen lajitteluohjeistus, A0 koossa: Ohjeeseen lisätään työmaa-alue suunnitelma, jossa on merkitty vaihtolavat ulkopuolella ja jäteastiat sisällä sekä jätehuollosta vastaavan henkilön nimi.

4 Erikseen kerättävät jätelajit

Jätehuollon suunnittelu tehdään työmaasuunnitelman mukaisesti vaiheittain, sillä eri rakennusvaiheissa syntyy erityyppisiä ja eri määriä jätteitä sekä tarvitaan erilaisia jäteasioita.

4.1 Työmaatoimisto ja sosiaalitalat

Toimitetaan laitoskäsittelyyn	Xxx:n kierrätysmateriaalien tuotantolaitokselle. Yhdyskuntajäte: sekajäteastia Jätteet menevät <u>kaatopaikalle</u> .
Keräysväline	Etukontti 1 kpl 600L
Tyhjennys	Tilauksesta
Keräysaika	Koko työmaan ajan

Toimitetaan laitoskäsittelyyn	Xxx:n kierrätysmateriaalien tuotantolaitokselle. Yhdyskuntajäte: paperiastia Jäte hyödynnetään <u>100 % materiaalina</u> .
Keräysväline	Etukontti 1 kpl 600L
Tyhjennys	Tilauksesta
Keräysaika	Koko työmaan ajan



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4.2 Rakennustyöjätteet

4.2.1 Puhdas maa- ja kiviaines

Toimitetaan laitoskäsittelyyn	Rakentamisen kelpaamattomat ylijäämämaat kuljetetaan pois rakennustyö- maalta EKE-Rakennus Oy:n osoittamaan paikkaan. Jäte hyödynnetään 100 % materiaalina tai täyttemaana.
Seloste	Pitää lajitella maa- ja kiviaines, jos > 800 tn.
Keräysaika	Perustukset ja maa- ja pohjarakenteet

4.2.2 Rakennussekajäte

Toimitetaan laitoskäsittelyyn	Xxx:n kierrätysmateriaalien tuotantolaitokselle. Jäte lajitellaan ja ohjataan hyödynnettäväksi joko materiaalina uusien tuotteiden valmistuksessa tai energiana. Rakennussekajätteen keskimääräinen hyötykäyttöaste on 90%. Loput menevät kaatopaikalle.
Seloste	Pitää lajitella rakennussekajäteistä betoni-, tiili-, keramiikka-, kipsilevy-, puujäte jos > 5 tn Eristeet, bitumi/kattohuvat, ikkunalasit, laastit ja sementit
Keräysväline	Vaihtolava 16 m ³
Tyhjennys	Tilauksesta
Keräysaika	Koko työmaan ajan

4.2.3 Betoni- ja tiilijätteet

Toimitetaan laitoskäsittelyyn	Rudus Oy:lle. Jäte hyödynnetään 100 % materiaalina (Betoroc-murske). → <i>Betoni- ja tiilijätteen siirtoasiakirja</i>
Seloste	Pitää lajitella betoni- ja tiilijäte, jos > 5tn. Voi sisältää kovettunutta muurauslaastia ja betoniharkkoja. Ei elementtien sau- mausmassoja, eristeitä tai puuta. Betonimurskeessa saa olla enintään 1% painosta muuta ainetta kuin betonia. → <i>Betoroc-murske ohje</i> → <i>Betoni- ja tiilijätteen vastaanottoehdot</i>



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Hinnat 2018	Lajike	Laatuluokka	Koko	Hinta	Yksikkö
	Betoroc- murske	BeM II	0/45 mm	2,50	€/t
	*Helsinki, Vantaa:				
	Luokittelu		Koodi	Hinta	Yksikkö
	Betonijäte, sivumitta alle 0,5 m, pulveroitu		8611	24,00	€/t
	Betonijäte, sivumitta alle 1 m		8612	24,00	€/t
	Betonijäte, sivumitta 1-5 m		8613	38,90	€/t
	Betonijäte, sisältää tiiltä		8607	50,53	€/t
	Betonijäte, erikoiskappaleet		8606	89,00	€/t
	Kevyet betonit		8608	89,00	€/t
	Tiilijäte		8609	29,91	€/t
	Ylijäämäbetoni		8600	24,00	€/t
	Perus/tarkastusmaksu		9525	35,00	€/kuorma
	Ohjelden vastainen kuorman tyhjennys		9524	150,00	€/kerta
	Lavan raavinta		9517	30,00	€/lava
	*Espoo:				
	Luokittelu		Koodi	Hinta	Yksikkö
	Betonijäte, sivumitta alle 0,5 m, pulveroitu		8611	24,00	€/t
	Betonijäte, sivumitta alle 1 m		8612	24,00	€/t
	Betonijäte, sivumitta 1-5 m		8613	38,90	€/t
	Betonijäte, sisältää tiiltä		8607	50,53	€/t
	Betonijäte, erikoiskappaleet		8606	89,00	€/t
	Kevyet betonit		8608	89,00	€/t
	Tiilijäte		8609	29,91	€/t
	Ylijäämäbetoni		8600	24,00	€/t
Keräysväline	Vaihtolava 8-10 m ³				
Tyhjennys	Tilauksesta (Espoo, Vantaa ja Helsinki)				
Keräysaika	Perustukset, runkovaihe ja muuraus				

4.2.4 Keramiikkajätteet

Toimitetaan laitoskäsittelyyn	Xxx:n kierrätysmateriaalien tuotantolaitokselle. Jätteet menevät <u>kaatopaikalle</u> .
Seloste	Laatat
Keräysväline	Jätteen keräyssäkki 1 m ³
Tyhjennys	Tilauksesta
Keräysaika	Laatoitustyöt (5-10% tilattu laatta)

4.2.5 Metallijäte

Toimitetaan laitoskäsittelyyn	Xxx:n kierrätysmateriaalien tuotantolaitokselle. Jäte hyödynnetään <u>100% materiaalina</u> .
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Seloste	Pitää lajitella metallijäte, jos > 50 kg/vko Tyhjät metalliset maalipurkit
Keräysväline	Vaihtolava 16 m ³
Tyhjennys	Tilauksesta
Keräysaika	Perustukset, runko-, vesikatto-, väliseinät vaihe

4.2.6 Puhdas puujäte ja puiset kuormalavat

Toimitetaan laitoskäsittelyyn	Xxx:n kierrätysmateriaalien tuotantolaitokselle. Jäte hyödynnetään 100 % energiana tai materiaalina .
Seloste	<p>Puurakenteet, kuten ovet, kaapit ja kalusteet, maalattu puu, pinnoitettu puu (melamiini), parketti, lastulevy, kimpilevy, lämpökäsitelty puu, vaneri, kovalevy, mdf- ja hdf-levyt, hirret, puretut betonilaudat.</p> <p>Ehjän puiset kuormalavat kerätään muusta puujätteestä erilleen ja toimitetaan Kuormalavojen Osto:n (Porvoo) tai Lavasuutarit Finlava Osto:n (Lähti) kuormalavakeskukseen. Lavat toimitetaan uudelleen käytettäväksi. Kerätään erikseen muusta puujätteestä koko työmaan ajan.</p> <p>Painekyllästetty puu → oma keräys</p> <p>Puurakenteet, joissa on suuria metalliosia tai materiaaleja, haltex-levyt, lamiinaatti → rakennussekajätettä</p> <p>OSB-levy → uudelleen käyttö työmaalla</p> <p>Kannot ja puunrungot → Sortti-aseilla kannot ja juurakot puutarhajätteeseen ja puunrungot risukeräykseen. Ämmäsuon jätteenkäsittelykeskuksessa kannot omina kuorminaan.</p>
Keräysväline	Vaihtolava 16 m ³
Tyhjennys	Tilauksesta
Keräysaika	Koko työmaan ajan

4.2.7 Kipsilevyjäte

Toimitetaan laitoskäsittelyyn	Gyproc Oy:lle Kirkkonummelle . Jäte hyödynnetään 100 % materiaalina . Lajiteltu kipsijäte murskataan, puhdistetaan ja kierrätetään kipsilevyteollisuuden raaka-aineena.
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Seloste	Pitää lajitella kipsilevyjäte, jos > 5tn. Käsittelemätön kipsilevyjäte. Puhtaat ja kuivat kipsilevyt: ei maalattuja tai tape-toituja tai säkeissä tai laattoja tai metallikappaleita tai lautarakenteita. → Ohjeita kierrätyskipsin lajitteluun ja kuljetukseen										
Hinnat 2018	<table> <tr> <td>Pienkuorma, peräkäräyt</td><td>20,00 €</td></tr> <tr> <td>Kertakäyttö kierrätys säkki (noin 500 kg)</td><td>30,00 € + säkin hävitys 10 €/säkki</td></tr> <tr> <td>Kuorma-autotoimitus, n. 10 m³ lava</td><td>80,00 €</td></tr> <tr> <td>Eurolava</td><td>30,00 € + lavan hävitys 10 €/lava</td></tr> <tr> <td>Trukkityöstä, lavojen hävityksestä ja muusta työstä</td><td>50,00 €/h (minimiveloitus 0,5 tuntia)</td></tr> </table>	Pienkuorma, peräkäräyt	20,00 €	Kertakäyttö kierrätys säkki (noin 500 kg)	30,00 € + säkin hävitys 10 €/säkki	Kuorma-autotoimitus, n. 10 m ³ lava	80,00 €	Eurolava	30,00 € + lavan hävitys 10 €/lava	Trukkityöstä, lavojen hävityksestä ja muusta työstä	50,00 €/h (minimiveloitus 0,5 tuntia)
Pienkuorma, peräkäräyt	20,00 €										
Kertakäyttö kierrätys säkki (noin 500 kg)	30,00 € + säkin hävitys 10 €/säkki										
Kuorma-autotoimitus, n. 10 m ³ lava	80,00 €										
Eurolava	30,00 € + lavan hävitys 10 €/lava										
Trukkityöstä, lavojen hävityksestä ja muusta työstä	50,00 €/h (minimiveloitus 0,5 tuntia)										
Keräysväline	Vaihtolava n.10 m ³										
Tyhjennys	Tilauksesta										
Keräysaika	Väliseinä ja alakatot vaihe										

4.2.8 Energiajäte (palava jäte, kuten styrox, muovit, polyuretaanilevyt)

Toimitetaan laitostäsittelyyn	Xxx:n kierrätysmateriaalien tuotantolaitokselle. Jäte hyödynnetään <u>100 % energiana</u> .
Seloste	Likaantuneet pahvit ja pakkausmateriaalit, muoviputket, polystyreeni ja PUR-läm-möneristeet (styrox ja finnfoam) Ei palamatonta jätettä, kuten metallia, kiveä tai lasia eikä PVC-muoveja.
Keräysväline	Jätepuristin
Tyhjennys	Tilauksesta
Keräysaika	Sisävalmistusvaihe

4.2.9 Pahvi- ja kartonkijätteet

Toimitetaan laitostäsittelyyn	Xxx:n kierrätysmateriaalien tuotantolaitokselle. Jäte hyödynnetään <u>100 % materiaalina</u> .
Seloste	Puhtaat ja kuivat suojapahvit, pahvilaatikot, kartonkiastiat.
Keräysväline	Pahvinkeräysrullakko → kannellinen jätekontti 6m ³
Tyhjennys	Tilauksesta
Keräysaika	Sisävalmistusvaihe



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4.2.10 Muovijätteet

Toimitetaan laitostäsitelyyn	Xxx:n kierrätysmateriaalien tuotantolaitokselle Erikseen kerätty muovipakkaukset jalostetaan <u>uusiomuovin raaka-aineeksi tai energiana</u> .
Seloste	Tyhjät muovipakkaukset ja kääreet, lavahuput, tyhjät sisä- ja raaka-ainesäkit, muoviämpärit, muut PE-kalvimuovit, kutiste- ja kiristekalvimuovit. Ei mustia jätösäkkejä, ei verkkoja, suursäkkejä, ei pakkausvanteita, ei styroxia, ei suuria määriä teippiä.
Keräysväline	Jätekontti
Tyhjennys	Tilauksesta
Keräysaika	Koko työmaan ajan

4.3 Ylijäämämateriaali

Toimitetaan laitostäsitelyyn	Netlet Oy AB:lle Ylijäämämateriaali toimitetaan <u>uudelleen käytettäväksi</u> .
Seloste	On kelpuutettu kaikki sellaiset tuote-erät, jotka ovat uusia, käyttökelpoisia ja käytettävissä alkuperäisessä tarkoituksessaan. Tuotteiden tulee olla ehjiä ja asianmukaisesti säilytetty. Myös tuotteiden määrä tulee olla selkeästi tiedossa. Kaikki käytettäviä tarvikkeita, kalusteita ja materiaaleja, joita voidaan hyödyntää jossain toisessa rakennus- tai remonttihankeessa. Ei ole minimimäärää, mutta järjen käyttö on sallittua. Mittatilaustyönä tehdyt kalusteet, ovet ja ikkunat, vaurioituneet tai vanhentuneet tuotteet sekä avatut tuotepakkaukset. Avatulla tuotepakkauksella tarkoitetaan esimerkiksi maalipurkkeja, tasoitesäkkejä, villapaketteja yms. → jäte → Saamme raportit kaikesta työmaaltamme noudetusta materiaalista yhtiön omia ympäristöraportteja varten.
Hinnat	Veloituksetta
Keräysväline	Noudettavat tuotteet tulee sijoitettuna sellaiseen paikkaan, josta nouto voidaan suorittaa mahdollisimman helposti sovittuna ajankohtana.
Tyhjennys	Tilauksesta
Keräysaika	Koko työmaan ajan



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4.4 Vaaralliset jätteet

Toimitetaan laitoskäsittelyyn	Aliurakoitsijat toimittavat omat vaaralliset jätteensä työmaalta vaarallisten jätteiden käsittelylaitokselle. Vaaralliset jätteet jalostetaan ongelmajätteeksi . → Ohjeistettava sopimusneuvottelussa / aliurakan aloituskokouksessa.
Seloste	Vaarallisia jätteitä ovat mm. maalit, liimat, jäteöljyt ja muut kemikaaleja sisältävät valmisteet, energiansäästölamput, loisteputket, paristot ja akut. Kyllästettyä puuta → Kestopuu:lle Kyllästettyä puuta (kestopuuta, painekyllästettyä puuta): vihreä ja ruskea suolakyllästetty puutavara sekä ruskea kreosoottikyllästetty puutavara.
Keräysväline	Erilleen muusta jäteastia Pidettävä erillään muista jätteistä ja toisistaan. Kyllästettyä puuta → Vihreä Kestopuu®-lava
Tyhjennys	Tilauksesta
Keräysaika	Koko työmaan ajan

5 Arviot jätemääristä jätelajeittain sekä jättekustannuksista

→ Liitteenä Excel tiedosto, jossa on mahdollista täyttää jätteiden määrä ja kustannus suunnitelma.

		käsittely				tyhjennus + maksu				kustannus		
		hinta	yksi.	määrä arvio	yksi.	%	hinta	yksi.	määrä arvio	yksi.	arvio €	
SUUNNITELMA	TYÖMAA											
	↗	Uudelleen käyttö	Metallijäte		€/tn	tn	#DIV/0!	€/krt		krt		0,00 €
				Kuormalavat		€/tn	tn	#DIV/0!	€/krt		krt	0,00 €
				OSB-levy		€/tn	tn	#DIV/0!	€/krt		krt	0,00 €
	+	Hyödynnetään 100% materiaalina	Bet.- ja tiilijäte		€/tn	tn	#DIV/0!	€/krt		krt	0,00 €	
				Kipsilevyjäte		€/tn	tn	#DIV/0!	€/krt		krt	0,00 €
				Pahvi- ja kartonki		€/tn	tn	#DIV/0!	€/krt		krt	0,00 €
		Hyödynnetään 100% energiana	Muovijäte		€/tn	tn	#DIV/0!	€/krt		krt	0,00 €	
				Energiajäte		€/tn	tn	#DIV/0!	€/krt		krt	0,00 €
				Puu-jäte		€/tn	tn	#DIV/0!	€/krt		krt	0,00 €
	↘	Hyödynnetään ≥ 70% energiana	Rakennussekajäte				#DIV/0!	€/krt		krt		0,00 €
			Kaatopaikka ≤ 30% Kaatopaikka	Keraamikkajäte		€/tn	tn	#DIV/0!	€/krt		krt	0,00 €
TYÖMAAN TOIMISTO												
+	Hyödynnetään 100% materiaalina	Paperijäte				tn	#DIV/0!	€/krt		krt		
		Kaatopaikka	Sekajäte				#DIV/0!	€/krt		krt		
YHTEENSÄ						0 tn	#DIV/0!		0 krt		0,00 €	



JÄTEHUOLTOSUUNNITELMA: UUDISRAKENTAMINEN
TYÖ xxxx

Luotu: xx.xx.20xx / XX
Päivitetty: 24.09.2018 / XX

6 Raportointi ja seuranta

Jätehuoltourakoitsija (Xxx) raportoi tilaajalle (EKE-Rakennus Oy) kertyneet rakennusjättemäärät **kerran kuukaudessa**. "Eri jätetyyppejä voidaan joutua toimittamaan eri käsittely-yhtiöille. Tämän vuoksi seurantaporttien tietoja voi joutua yhdistelemään itse."

→ Liitteenä Excel tiedosto, jossa on mahdollista täyttää jätteiden määrä (tn/brm3) seuranta. Tyhjennys + maksu (kerta) ja käsittely (tonni) ovat erotettu.

→ Liitteenä Excel tiedosto, jossa on mahdollista täyttää jätteiden kustannus (€/brm2) seuranta. Tyhjennys + maksu (kerta) ja käsittely (tonni) ovat erotettu.

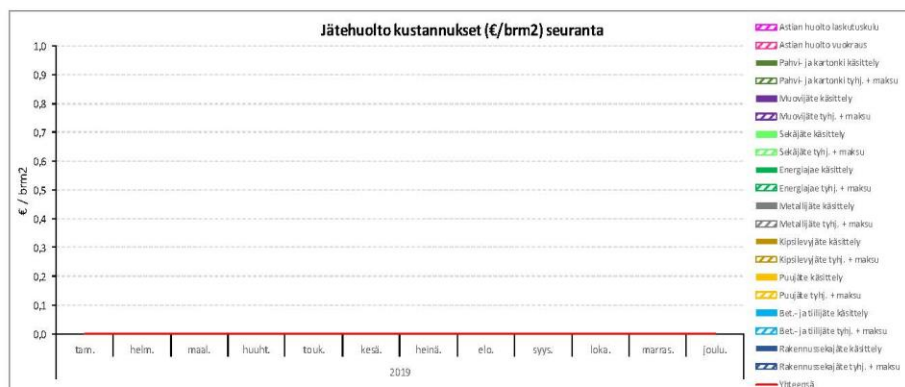
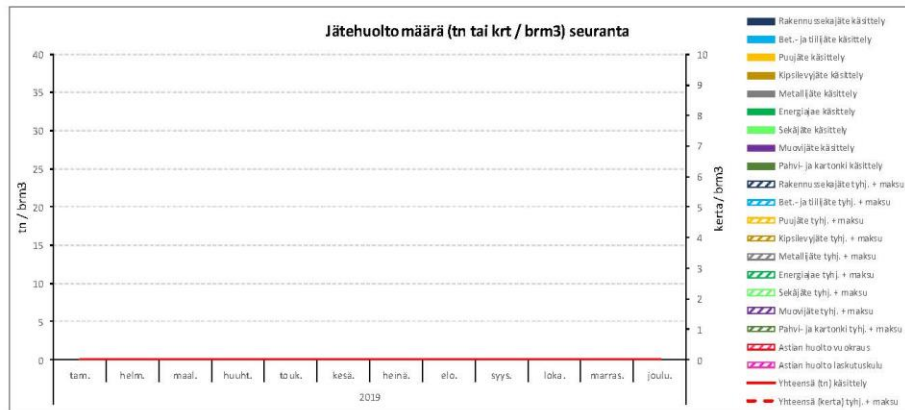
tyhj. + maksu: tyhjennys + punnitus-, perus- ja kuormamaksu ja toimitus
käsittely: hyödynnetty





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→ Järjestys ja jätehuolto -turvallisuuden tasoa seurataan Site-Managerilla. Pitäisi olla ainakin 200 havaintoa per rakennus, jossa on yksi hissi / porrashuone.

Suunnitelman laati, xx.xx.2018

XXX

Päivitykset:

päivämäärä	aihe
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EKE-Rakennus Oy, building site cleaning plan

PUHTAUDENHALLINTASUUNNITELMA: UUDISRAKENTAMINEN
TYÖ xxxx

Luotu: xx.xx.20xx / XX
Päivitetty: xx.xx.20xx / XX

Puhtaudenhallintasuunnitelma: Uudisrakentaminen**Työmaan yleistiedot:**

Kohteen nimi:	As Oy xxxxxxxx,	Xxxx
Osoite:	XXXXX XXXXXX	xxx
Työnumero:		XXXX
Rakennustoimenpide ja tilavuus:		xx m ³
Rakennus aika:		vko xx/xx – xx/xx

Perustajaurakoitsija:	EKE- Rakennus Oy	Piispanportti 7 02240 ESPOO
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Projektipäällikkö:	Xxx	040 xxx xxxx
Vastaava mestari:	Xxx	040 xxx xxxx
Työnjohtaja:	Xxx	040 xxx xxxx
	Xxx	040 xxx xxxx
Työmaainsinööri:	Xxx	040 xxx xxxx



PUHTAUDENHALLINTASUUNNITELMA: UUDISRAKENTAMINEN
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1. Puhtaudenhallinnan valvonta

Puhtaudenhallintaa valvotaan työmaalla EKE-Rakennus Oy:n työnjohdon toimesta koko ajan töiden edessä ja mahdollisiin epäkohtiin puututaan heti. Viikoittaisen TR-kierroksen yhteydessä mahdolliset epäkohdat dokumentoidaan tarkastuslomakkeeseen sekä tarvittaessa informoidaan aliurakoitsijoiden työnjohtoa. Mahdolliset puhtaudenhallinnan epäkohdat käsitellään urakoitsijapalaverissa. Urakoitsijan laiminlyödessä puhtaudenhallintavelvoitteensa, asiasta huomautetaan viipymättä ja mikäli asiassa ei tapahdu parannusta, EKE-Rakennus Oy siivouttaa/suojaa kohteen ja perii urakoitsijalta maksun työsuorituksista ko. urakoitsijan tuntityöhinnalla mukaisesti.

2. Pölynhallinta rakentamisessa

Rakentamistyön pölynhallinnan tavoitteena on vähentää työssä syntyvän pölyn määrää ja minimoida pölyn leviäminen työpisteestä työmaan muihin tiloihin sekä estää työntekijöille aiheutuvat haitat. Pölynhallintasuunnitelmassa esitetään menetelmät ja toimenpiteet pölynhallintaan.

Pölynhallinnan keinoja ovat vähän pölyä synnyttävien tai pölyämättömien työmenetelmien käyttö, kohdepoistojen käyttö pölyävissä työvaiheissa, työmaa-alueiden eristys sekä pölyä synnyttävien töiden suorittaminen erillisessä tehtävään varatussa tilassa.

Pölynhallinnan järjestys on:

- 1. Pölyn vähentäminen: ehkäisy (parempi suunnittelu: pienentä korjaukset)
- 2. Pölyn torjunta
- 3. Pölysuojaus työntekijöille ja materiaaleihin
- 4. Pölyn poisto

3. Pölyn torjunta

Tupakointi on rakentamisen aikana kielletty sisätiloissa. Aluesuunnitelmaan on merkitty tupakointipaikat, joissa tupakointi on sallittu.

Koneissa kohdepoistolaitteisto ja oikea suodatin. Laastin valmistus asuintilan ulkopuolella.

Pölyävät alueet eristetään väliaikaisilla ovilla tiloista, joissa ei ole pölyäviä töitä. Eristetty alue pidetään suljettuna. Huolehditaan ilmoituksista, kts "Alue eristetty voit kulkea tästä, sulje ovi". Kun loppusiivous alkaa, pölyttömien asuntojen on oltava suljettuna.

4. Materiaalien, tilojen ja henkilöiden suojaus

Materiaalit tilataan pääsääntöisesti täsmätoimituksina suoraan työkohteeseen. Turhaa varastointia työmaa-alueella vältetään. Mikäli rakennusmateriaaleja joudutaan varastoimaan työmaalla, urakoitsija huolehtii niiden suojauksesta pölyä ja kosteutta vastaan.



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Sisävalmistusvaiheessa laitetaan pintamateriaaleihin (ikkunat ja ovet, lattiat, portaat, hissit ja kalusteet) suojaukset: muovi ja / tai pahvi ja kartonki. Suojataan LVI-putket ja -laitteet.

Kun tehdään pölyäviä töitä, käytössä vähintään P2-luokan hengityksensuojain.

5. Siivoussuunnitelma

Sisävalmistusvaiheessa urakoitsijat toimittavat työssään syntyvät jätteet lajiteltuina porrashuoneisiin tasolle, jossa työ on tehty. Ulkopuolen jätteet laitetaan roskakärryihin. Työpisteet siivotaan joka päivä päivän päätteeksi. Työpisteen siivous tulee suorittaa heti pölyävän työvaiheen tai tehtävän jälkeen. Jokainen aliurakoitsija siivoaa oman työnsä jäljet.

Työmaalla on kokopäiväisesti 1-2 rakennussiivoojaa, jotka huolehtivat pölyn ja hienompien jätteiden poistosta. Ylläpitosiivous, erityisesti yhteistiloissa, jotka ovat varasto tiloja (1 kertaa /viikko) ja porrashuoneet ja käytävät (2 kertaa /viikko). Ennen tasoitus- ja maalaustöiden aloitusta työkohteet imuroidaan huolellisesti. Jäteastiat tyhjennetään heti, kun ne ovat täynnä.

Siivous tapahtuu lastaa käyttäen, hienoin pöly poistetaan keskuspölynimurilla, jossa on Hepa-suodatin. Mikäli keskusimuria ei ole mahdollista käyttää, käytetään teollisuuspölynimuria.

6. Rakennusmateriaalien päästöt

Materiaaleille on asetettu vähäpäästöisyysvaatimukset. Materiaalien sallitut VOC-pitoisuudet on esitetty liitteessä 1.

7. Pölynhallinta rakentamisen aikana

Rakennuksen porrashuone lohkoon tulee keskuspölynimurijärjestelmä. Tätä järjestelmää käytetään hyväksi koko hankkeen ajan niin, että esimerkiksi hiomakoneet liitetään imuriin työn ajaksi. Pölyntorjunta on tärkeää paitsi työ- maaympäristölle, myös työterveyden kannalta. Sisätyön valmistautuminen (esim.: laastin valmistus, sahaus ja muut pölyä aiheuttavat työt) tulee mahdollisuuksien mukaan tehdä rakennuksen ulkopuolella. Mikäli tämä ei ole mahdollista, on suojaukseen, alipaineistukseen ja siivoukseen kiinnitettävä erityistä huomiota. Kaikki jätteet lajitellaan. Ohjeistus erillisen jätahuoltosuunnitelman mukaisesti.

→ Työmaan siivousohjeistus, A2 koossa: Ohjeeseen lisätään siivoushuollosta vastaavan henkilön nimi.

PÖLYNHALLINNAN RISKIANALYYSI

Työvaihe / tekemistä	Riski	Toimenpide	Vastuu
Yleinen, koko työmaan ajan	-työmaateiden ja työmaa-alueen pölyäminen kuivalla säällä	-pölynsidonta, suolaus	maanrakennusurakoitsija
Paalutus	-paalujen katkaisusta aiheutuva pöly	-paalujen katkaisussa käytetään vettä sitomassa pölyä	paalutusurakoitsija



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Piikkaustyöt	-pölyn leviäminen muihin tiloihin	-eristäminen ja riittävä imurointi, siivous heti piikkaustyön jälkeen -käytetään henkilökohtaisia suojavälineitä	EKE / Aliurakoitsijat
Laastien ja tasoitteiden sekoitus	-kuiva-ainepölyn leviäminen muihin tiloihin	-osoitetaan laasteille ja tasoitteille erillinen, hyvin suojattu, sekoituspaikka -käytetään henkilökohtaisia suojavälineitä	EKE / Aliurakoitsijat
Puutavaran työstö	-hioma- ja sahauspölyn leviäminen	-puuntyöstölle oma osastoitu paikka, sirkkeliä käytetään pääasiassa ulkotiloissa -sirkkeli liitetään keskuspölynimuriin sisätyövaiheessa -siivous heti työvaiheen jälkeen	EKE / Aliurakoitsijat
Betonilattioiden hiontatyöt	-betonipölyn leviäminen muihin tiloihin	-hiomakoneen liittäminen keskuspölynimuriin -imurointi välittömästi hionnan jälkeen -käytetään henkilökohtaisia suojavälineitä	EKE / Aliurakoitsijat
Villaeristystyö	-eristepölyn leviäminen muihin tiloihin	-eristeleikkaukset tehtävä huolellisesti työtiloissa -huomioitava myös henkilökohtainen suojausvarustus	EKE / Aliurakoitsijat
Seinien hiontatyöt	-hiomisesta aiheutuva pöly	-hiomakoneen liittäminen keskuspölynimuriin -työalueen imurointi työn jälkeen -käytetään henkilökohtaisia suojaimia	EKE / Aliurakoitsijat
Tasoitetyöt	-tasoitteen aiheuttama pöly -tasoitteen hionnasta aiheutuva pöly	-työalueen imurointi ennen työn aloittamista -tarvittaessa tasoitettava alue (asunnot) eristetään -tasoitetyön aikana ei muita urakoitsijoita samassa osastossa -käytetään henkilökohtaisia suojaimia (hengityssuojaimet)	EKE / Aliurakoitsijat
Maalaukset	-ruiskulla maalatessa maalisumun ja pölyn leviäminen	-maalaukkojen lattia imuroidaan ennen työn aloitusta -maalatessa käytetään hengityssuojaimia -tarvittaessa työkohteeseen suojataan	EKE / Aliurakoitsijat
Siivous ja raivaus	-siivottavien alueiden pölyn leviäminen	-runkovaiheessa karkea siivous tehdään lastaa käyttäen, harjaa ei käytetä -käytetään keskuspölynimurijärjestelmää	EKE



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		-imurin suodattimet tarkistetaan ja puhdistetaan säännöllisesti -siivous tehdään päivittäin	
IV-laitteiden ja –kanavien pölytyminen	-putkien sisäpuolelle menevä pöly	-pidetään ilmastointiputkien päissä kuljetuksen, varastoinnin ja asennuksen aikana suojatulppia ja huolehditaan niiden kunnosta -suojataan asennetut IV-koneet -iv-koneita ei käytetä rakennustyön aikana, koneet kytetään päälle koekäyttöä varten noin kuukausi ennen kohteen luovutusta	IV-urakoitsija
Loppusiivous	-pölyn leviäminen	-tehdään ensin karkea siivous, jossa imuroidaan tilat ja poistetaan suojat -tämän jälkeen tehdään siivous kostealla tai pintamateriaalitoimittajan ohjeiden mukaan	loppusiivousurakoitsija
Luovutus	-pölyn leviäminen -pinta näyttää likaiselta	-työpisteillä suoritetaan päivittäin siivousta. -tehdään tarkastuspöytäkirja P2-puhtaustaso.	EKE / Aliurakoitsijat

8. Arviot pölynhallinta määräistä sekä kustannuksista

→ Liitteenä Excel tiedosto, jossa on mahdollista täyttää pölynhallinta laitteiden ja työn määrä ja kustannus suunnitelma. Materiaali, vuokraus materiaali ja työ ovat eritelty.

Materiaali

Vuokraus materiaali

Työ

			hinta	yksikkö	määrä arvio	yksikkö	Kustannus arvio €	Kustannus % arvio
SUUNNITELMA	TORJUNTA	Pölyväien alueiden eristys	Väli-aikainen ovi	€/kpl		kpl	0,00 €	#DIV/0!
			Sähkötyökalu	€/kpl		kpl	0,00 €	#DIV/0!
		Työkalut integroitu pölynpoisto kerääjä	Lisävaruste	€/kpl		kpl	0,00 €	#DIV/0!
			Muut	€/kpl		kpl	0,00 €	#DIV/0!
	POISTO	Kohdepoisto	Teollisuusimurit vuokra	€/15pv		kpl	0,00 €	#DIV/0!
			Keskusimurit vuokra	€/15pv		kpl	0,00 €	#DIV/0!
		Siivous ja raivaus	Siivoustyö	€/h		h/projekti	0,00 €	#DIV/0!
	SUOJAUS		Hengityksensuojaimet	€/kpl		kpl	0,00 €	#DIV/0!
		Muut	Hepa suodatin	€/kpl		kpl	0,00 €	#DIV/0!
			Ilmanpuhdistimet	€/kpl		kpl	0,00 €	#DIV/0!

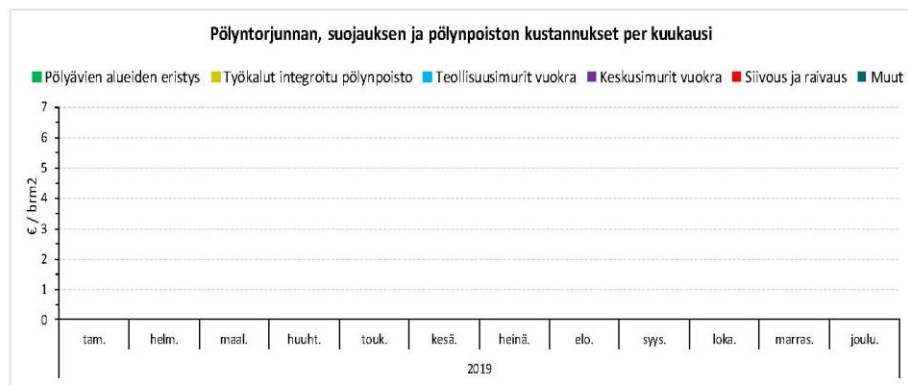
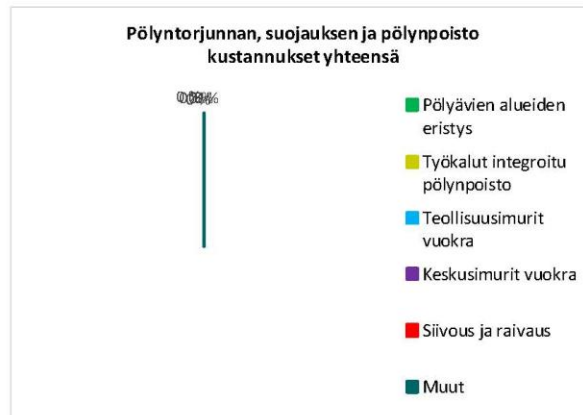


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9. Raportointi ja seuranta

→ Liitteenä Excel tiedosto, jossa on mahdollista täyttää pölynhallinta laitteiden ja työn kustannus (€/brm2) seuranta.



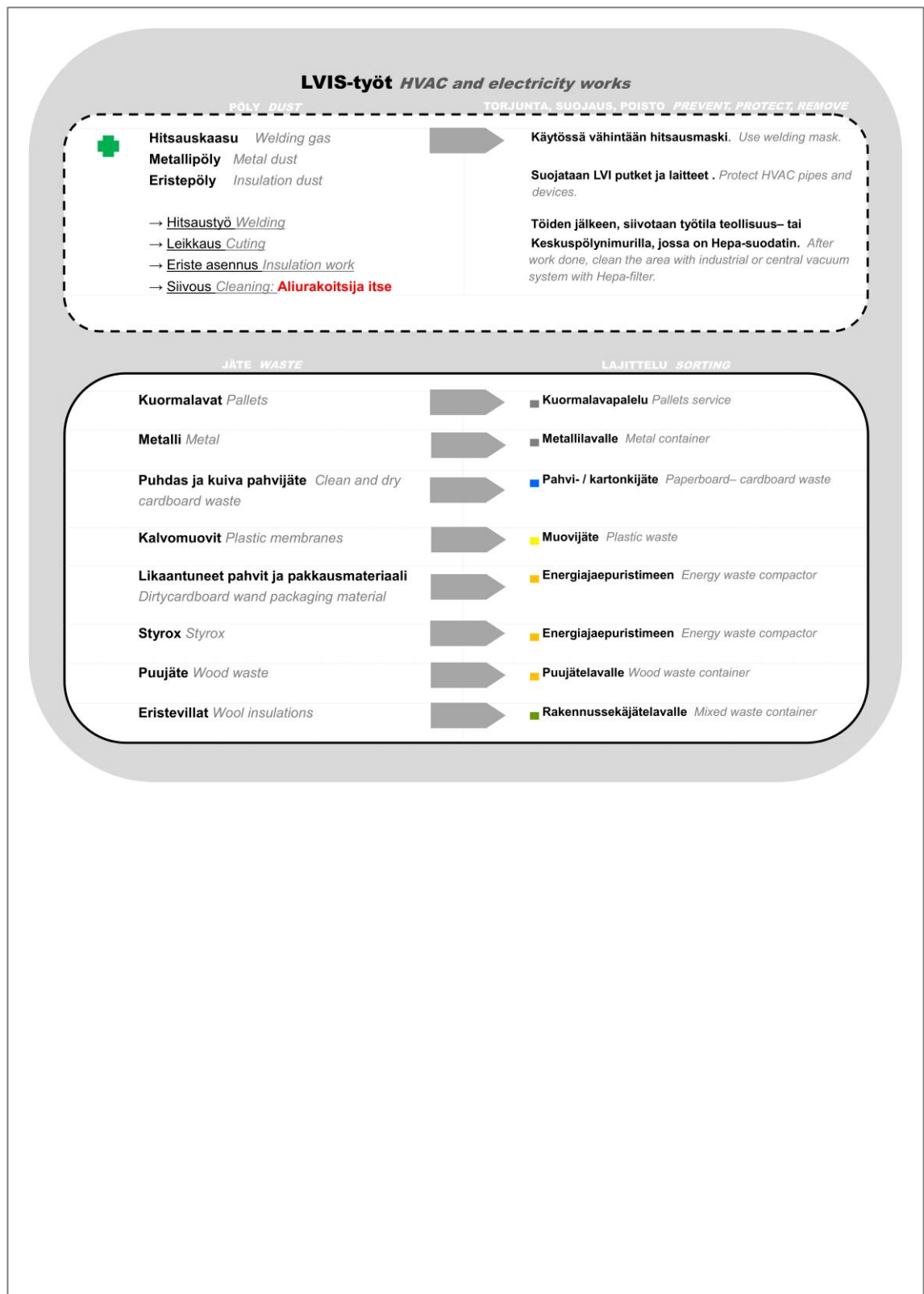
Suunnitelman laati, xx.xx.2018

Xxx

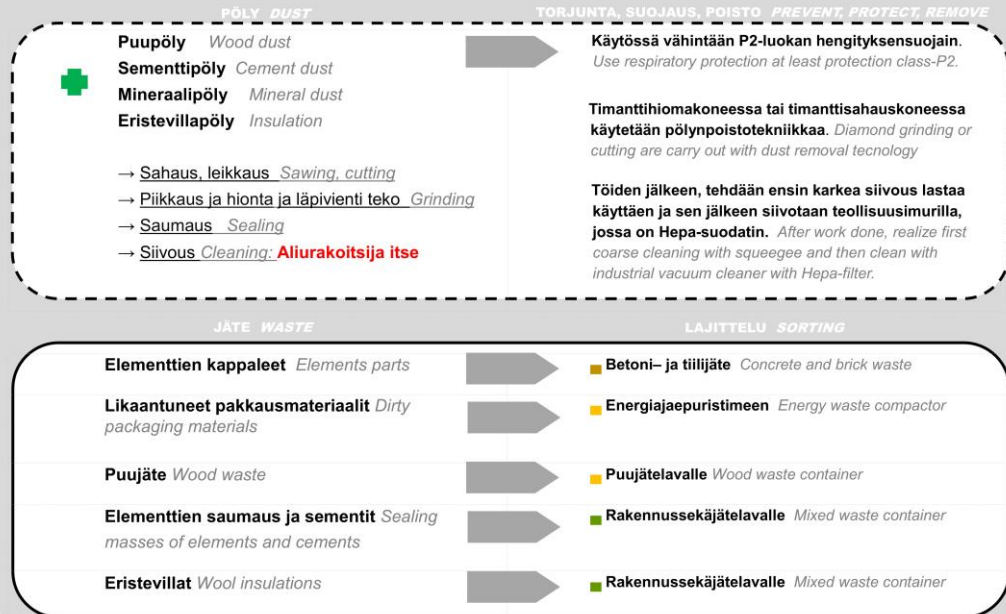
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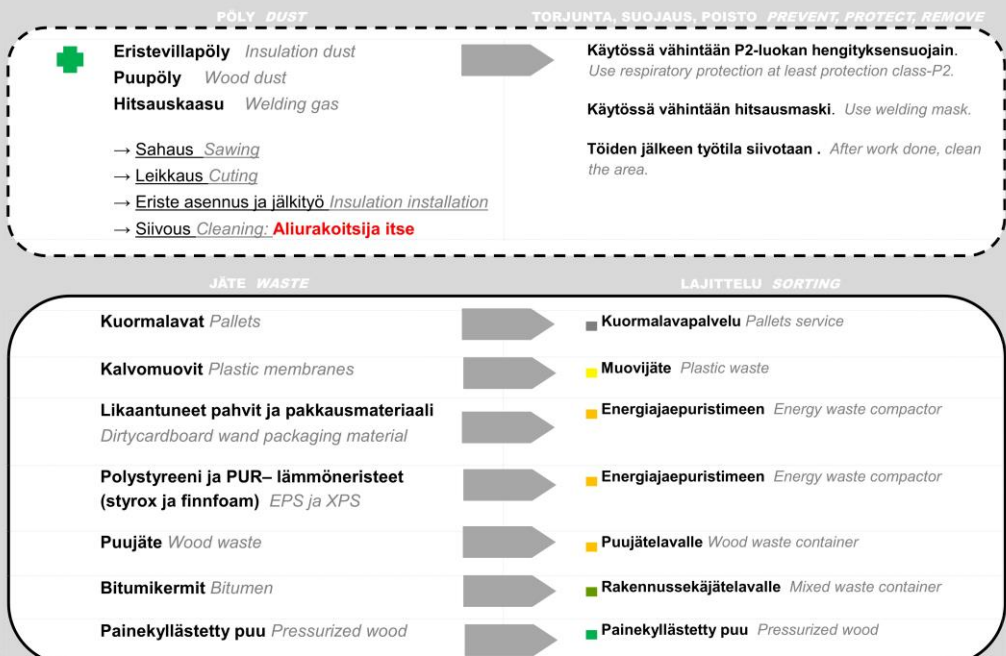
EKE-Rakennus Oy, building site cleaning and waste management guideline



Elementtiasennus Prefabricated elements installation



Vesikattotyö Roof work



Muuraustyö *Masonry work*

POLY DUST

TORJUNTA, SUOJAUS, POISTO PREVENT, PROTECT, REMOVE



Sementtipöly *Cement dust*
Mineraalipöly *Mineral dust*

- Laastin valmistus *Mortar preparation*
- Tiilien saumaus *Bricks sealing*
- Leikkaus *Cutting*
- Siivous *Cleaning*: **Aliurakoitsija itse**

Koneissa kohdepoistolaitteisto ja oika suodatin.
Machine with integrated dust collector and correct dust filter.

Laastin valmistus asuintilan ulkopuolella *Mortar preparation outside of living area.*

Käytössä vähintään P2-luokan hengityksensuojain.
Use respiratory protection at least protection class-P2.

Töiden jälkeen, tehdään ensin karkea siivous lastaa käyttäen ja sen jälkeen siivotaan teollisuusimurilla, jossa on Hepa-suodatin. *After work done, realize first coarse cleaning and then clean with industrial vacuum cleaner with Hepa-filter.*

JÄTE WASTE

LAJITTELU SORTING

Kuormalavat *Pallets*Kuormalavapalvelu *Pallets service*Tiili- ja laastijäte *Brick and mortar waste*Betoni- ja tiilijätelavalle *Concrete and brick waste container*Laastisäkit *Mortar sacks*Muovijäte *Plastic waste*Kalvomuovit *Plastic membranes*Muovijäte *Plastic waste*Puujäte *Wood waste*Puujätelavalle *Wood waste container*

Ikkuna- ja ovi-asennus *Windows and doors installation*

POLY DUST

TORJUNTA, SUOJAUS, POISTO PREVENT, PROTECT, REMOVE

- Siivous *Cleaning*: **Aliurakoitsija itse**

Töiden jälkeen, siivotaan työtila teollisuus- tai Keskuspölynimurilla, jossa on Hepa-suodatin. *After work done, clean the area with industrial or central vacuum system with Hepa-filter.*

JÄTE WASTE

LAJITTELU SORTING

Kuormalavat *Pallets*Kuormalavapalvelu *Pallets service*OSB-levy (suojaus) *OSB-panel (protection)*Uudelleen käyttö työmaalla *Reused on-site*Puhdas ja kuiva pahvijäte *Clean and dry cardboard waste*Pahvi- / kartonkijäte *Paperboard- cardboard waste*Pakkaus ja suojaus muovit *Packaging and protection plastic*Muovijäte *Plastic waste*Likaantuneet pahvit ja pakkausmateriaali *Dirty cardboard and packaging material*Energiajääpuristimeen *Energy waste compactor*Puujäte *Wood waste*Puujätelavalle *Wood waste container*Uretaanijäte *Urethane waste*Rakennussekäjätelavalle *Mixed waste container*Uretaanipullo *Urethane spray*Vaarallisten jätteiden keräykseen *Hazardous waste collection*

Väliseinä ja alakattotyö *Partition wall and false ceiling work*

PÖLY DUST

TORJUNTA, SUOJAUS, POISTO PREVENT, PROTECT, REMOVE



Kipsilevy pöly *Plasterboard dust*
Puupöly *Wood dust*

- Sahaus (sauna: kertopuu) *Sawing (sauna)*
- Leikkaus *Cutting*
- Siivous *Cleaning*: **Aliurakoitsija itse**

Koneissa kohdepoistolaitteisto ja oikein suodatin.
Machine / tool with integrated dust collector and correct dust filter.

Töiden jälkeen, siivotaan työtila keskuspölynimurilla, jossa on Hepa-suodatin.
After work done, clean the area with the central vacuum system with Hepa-filter.

JÄTE WASTE

LAJITTELU SORTING

Kuormalavat *Pallets*Kuormalavapalvelu *Pallets service*Metalli *Metal*Metallikeräykseen *Metal collection*Kipsilevyt *Plasterboards*Kipsilevyjäte *Plasterboard waste*Kalvomuovit *Plastic membranes*Muovijäte *Plastic waste*Puujäte *Wood waste*Puujätelavalle *Wood waste container*Eristevillat *Insulation wools*Rakennussekäjätelavalle *Mixed waste container*

Vedeneristys- ja laatoitustyö *Waterproofing and tiling work*

PÖLY DUST

TORJUNTA, SUOJAUS, POISTO PREVENT, PROTECT, REMOVE



Puupöly *Wood dust*
Mineraalipöly *Mineral dust*
Kemikaalit *Chemicals*

- Laastin valmistus *Mortar preparation*
- Tasoitetyö *Screeding*
- Sahaus *Sawing*
- Leikkaus *Cutting*
- Saumaus *Seaming*
- Siivous *Cleaning*: **Aliurakoitsija itse**

Koneissa kohdepoistolaitteisto ja oikein suodatin.
Machine / tool with integrated dust collector and correct dust filter.

Laastin valmistus asuintilan ulkopuolella.
Mortar preparation outside of living area.

Käytössä vähintään P2-luokan hengityksensuojain kaasuille ja hiukkasille.
Use fine particle mask at least protection class-P2.

Töiden jälkeen, siivotaan työtila keskuspölynimurilla, jossa on Hepa-suodatin.
After work done, clean the area with the central vacuum system with Hepa-filter.

JÄTE WASTE

LAJITTELU SORTING

Kuormalavat *Pallets*Kuormalavapalvelu *Pallets service*Puhdas ja kuiva pahvijäte *Clean and dry cardboard waste*Pahvi- / kartonkijäte *Paperboard- cardboard waste*Pahviset tasoitesäkit *Screeding sacks*Pahvi- / kartonkijäte *Paperboard- cardboard waste*Muoviset tasoitesäkit *Screeding sacks*Muovijäte *Plastic waste*Muoviämpärit *Plastic buckets*Muovijäte *Plastic waste*Puujäte *Wood waste*Puujätelavalle *Wood waste container*Laatat hukka *Tiles loss*Keramiikkajäte *Tiles waste*

Tasoite- ja maalaustyö *Screeding and painting work*

PÖLY DUST

TORJUNTA, SUOJAUS, POISTO PREVENT, PROTECT, REMOVE



Sementti pöly *Cement dust*
Mineraali pöly *Mineral dust*
Kemikaalit *Chemicals*

- [Laastin valmistus](#) *Mortar preparation*
- [Tasoitetyö](#) *Screeding*
- [Hionta](#) *Sanding*
- [Maalaustyö](#) *Painting*
- [Siivous](#) *Cleaning*: **Aliurakoitsija itse**

Pölyävät alueet eristetään väliaikaisilla ovilla tiloista, joissa ei ole pölyäviä töitä. *Dusty areas are isolated by temporary doors from spaces where there is not dusty work.*

Koneissa kohdepoistolaitteisto ja oikea suodatin. *Machine with integrated dust collector and correct dust filter.*

Laastin valmistus asuintilan ulkopuolella. *Mortar preparation outside of living area.*

Käytössä vähintään P2-luokan hengityksensuojain kaasuille ja hiukkasille ja hiukkassuojain. *Use fine particle respiratory protection at least protection class-P2.*

Töiden jälkeen, siivotaan työtila keskuspolynimurilla, jossa on Hepa-suodatin. *After work done, clean the area with the central vacuum system with Hepa-filter.*

JÄTE WASTE

LAJITTELU SORTING

Tyhjät metalliset maalipurkit *Empty metal paint cans*

■ **Metallikeräykseen** *Metal collection*

Tasoitesäkit *Screeding sacks*

■ **Muovijäte** *Plastic waste*

Muoviämpärit *Plastic buckets*

■ **Energiajsepuristimeen** *Energy waste compactor*

Hiontapöly *Sanding dust*

■ **Rakennussekäätelavalle** *Mixed waste container*

Vajaat maalipurkit *Paint cans*

■ **Vaarallisten jätteiden keräykseen** *Hazardous waste collection*

Laminaatti-, parketti ja mattotyö *Laminate, parquet and carpet work*

PÖLY DUST

TORJUNTA, SUOJAUS, POISTO PREVENT, PROTECT, REMOVE



Puupöly *Wood dust*
Kemikaalit *Chemicals*

- [Sahaus](#) *Sawing*
- [Parkettiasennus ja hionta](#) *Parquet installation and grinding*
- [Siivous](#) *Cleaning*: **Aliurakoitsija itse**

Pölyävät alueet eristetään väliaikaisilla ovilla tiloista, joissa ei ole pölyäviä töitä. *Dusty areas are isolated by temporary doors from spaces where there is not dusty work.*

Koneissa kohdepoistolaitteisto ja oikea suodatin. *Machine with integrated dust collector and correct dust filter.*

Käytössä vähintään P2-luokan hengityksensuojain kaasuille ja hiukkasille ja hiukkassuojain. *Use fine particle respiratory protection at least protection class-P2.*

Töiden jälkeen, siivotaan työtila keskuspolynimurilla, jossa on Hepa-suodatin. *After work done, clean the area with the central vacuum system with Hepa-filter.*

JÄTE WASTE

LAJITTELU SORTING

Kuormalavat *Pallets*

■ **Kuormalavapalvelu** *Pallets service*

Puhdas ja kuiva pahvijäte *Clean and dry cardboard waste*

■ **Pahvi- / kartonkijäte** *Paperboard- cardboard waste*

Kalvomuovit *Plastic membranes*

■ **Muovijäte** *Plastic waste*

Puujäte ja parketti *Wood waste and parquet*

■ **Puujätelavalle** *Wood waste container*

Laminaatti *Laminate*

■ **Rakennussekäätelavalle** *Mixed waste container*

PVC-muovimatto *PVC-plastic carpet*

■ **Rakennussekäätelavalle** *Mixed waste container*

Listoitustyö *Listing work*

PÖLY DUST

TORJUNTA, SUOJAUS, POISTO PREVENT, PROTECT, REMOVE

Puupöly *Wood dust*

- Leikkaus *Cutting*
- Poraus *Drilling*
- Siivous *Cleaning*: **Aliurakoitsija itse**

Koneissa kohdepoistolaitteisto ja oikein suodatin.
Machine / tool with integrated dust collector and correct dust filter.

Töiden jälkeen, siivotaan työtila keskuspölynimurilla Hepa-suodattimella
After work done, clean the area with central vacuum system with Hepa-filter.

JÄTE WASTE

LAJITTELU SORTING

Pelti *Tin plate*

■ **Metallikeräykseen** *Metal collection*

Kalvomuovit *Plastic membranes*

■ **Muovijäte** *Plastic waste*

Puujäte *Wood waste*

■ **Puujätelavalle** *Wood waste container*

PVC-jäte *PVC-waste*

■ **Rakennussekäjätelavalle** *Mixed waste container*

Uretaanijäte *Urethane waste*

■ **Rakennussekäjätelavalle** *Mixed waste container*

Sauna ja paneelityö *Sauna and wood panels work*

PÖLY DUST

TORJUNTA, SUOJAUS, POISTO PREVENT, PROTECT, REMOVE

Puupöly *Wood dust*

- Siivous *Cleaning*: **Aliurakoitsija itse**

Koneissa kohdepoistolaitteisto ja oikea suodatin.
Machine / tool with integrated dust collector and correct dust filter.

Töiden jälkeen, siivotaan työtila keskuspölynimurilla, jossa on Hepa-suodatin.
After work done, clean the area with central vacuum system with Hepa-filter.

JÄTE WASTE

LAJITTELU SORTING

Kalvomuovit *Plastic membranes*

■ **Muovijäte** *Plastic waste*

SPU-eristeet *Urethane insulation*

■ **Energiajaepuristimeen** *Energy waste compactor*

Puujäte *Wood waste*

■ **Puujätelavalle** *Wood waste container*

Alumiiniteippi *Aluminium tape*

■ **Rakennussekäjätelavalle** *Mixed waste container*

Kalustetyö Furniture work

PÖLY DUST

TORJUNTA, SUOJAUS, POISTO PREVENT, PROTECT, REMOVE



Puupöly Wood dust

- Sahaus *Sawing*
- Leikkaus *Cutting*
- Siivous *Cleaning*: **Aliurakoitsija itse**

Pölyävät alueet eristetään väliaikaisilla ovilla tiloista, joissa ei ole pölyäviä töitä. Dusty areas are isolated by temporary doors from spaces where there is not dusty work.

Koneissa kohdepoistolaitteisto ja oikea suodatin. Machine / tool with integrated dust collector and correct dust filter.

Töiden jälkeen, siivotaan työtila keskuspölynimurilla, jossa on Hepa-suodatin. After work done, clean the area with the central vacuum system with Hepa-filter.

JÄTE WASTE

LAJITTELU SORTING

Kuormalavat *Pallets*

Kuormalavapalvelu *Pallets service*

Puhdas ja kuiva pahvijäte *Clean and dry cardboard waste*

Pahvi- / kartonkijäte *Paperboard- cardboard waste*

Kalvomuovit *Plastic membranes*

Muovijäte *Plastic waste*

Styrox *Styrofoam*

Energiajääpuristimeen *Energy waste compactor*

Puujäte *Wood waste*

Puujätelavalle *Wood waste container*

Kodinkoneet ja varusteet Home appliances and accessories

PÖLY DUST

TORJUNTA, SUOJAUS, POISTO PREVENT, PROTECT, REMOVE

Puupöly *Wood dust*

Mineraalipöly *Mineral dust*

- Poraus (sälekaihtimet) *Drilling (blinds)*

Töiden jälkeen, siivotaan työtila keskuspölynimurilla, jossa on Hepa-suodatin. After work done, clean the area with the central vacuum system with Hepa-filter.

Sälekaihtimien asennus ennen ikkunoiden pesua. Blinds installation before windows cleaning.

JÄTE WASTE

LAJITTELU SORTING

Puhdas ja kuiva pahvijäte *Clean and dry cardboard waste*

Pahvi- / kartonkijäte *Paperboard- cardboard waste*

Kalvomuovit *Plastic membranes*

Muovijäte *Plastic waste*

Yleissiivous *General cleaning*

PÖLY DUST

TORJUNTA, SUOJAUS, POISTO PREVENT, PROTECT, REMOVE

→ Siivous *Cleaning*

Ylläpito siivous keskuspölynimurilla, erityisesti yhteistiloissa = varastotilat ja porrashuoneet.
Maintenance cleaning, with central vacuum system, especially in common spaces = stockage areas and staircases.

Jäteastoiden ja vaihtolavojen siivous. *Waste bins and containers cleaning.*

Keskuspölynimurin käyttö kun sisävalmistustyöt alkavat
Central vacuum system used when interior works start.

Karkea siivous tehdään lastaa käyttäen. *Rough cleaning is done using a squeegee.*

Harjaa ei saa käyttää. *Sweep can not be used.*

JÄTE WASTE

LAJITTELU SORTING

Viedään täydet lajitellut jäteastiat
Bring the full sorted bin waste

Oikeille vaihtolavoille.
To the correct containers

Loppusiivous *Final cleaning*

PÖLY DUST

TORJUNTA, SUOJAUS, POISTO PREVENT, PROTECT, REMOVE

Kemikaalit *Chemicals*→ Suojausten poistaminen *Protection removal*→ Siivous *Cleaning***2 siivous vaiheetta: 2 cleaning steps:**

- ennen ilmanvaihdon toimintakokeita ja
 - ennen rakennuksen luovutusta.
- : before ventilation tests and before handover.*

Siivous ylläpidetään rakentamisen alusta loppusiivoukseen ensimmäiseen vaiheeseen asti.
Cleaning is maintained from the beginning of the construction to the first stage of final cleaning.

Kun toimintakoe alkaa, rakennus on pölytön ja ei ole enää pölyviä töitä. *When the operating test start, the building is dust-free and there is not anymore dusty work.*

Rakennuksen taso-, pysty- ja lattiapinnat imuroidaan teollisuusimurilla Hepa-suodattimella, pesu menetelmä nihkeä- ja kostea pyyhintä lastalla.
Vertical and horizontal surfaces are cleaned with industrial vacuum cleaner with Hepa-filter, wet wiping and washing methods.

Pölyttömät alueet eristetään ovilla tiloista, joissa vielä suoritetaan rakennus- tai asennustöitä. *Dust-free areas are isolated by doors from spaces where there is still construction or installation work.*

JÄTE WASTE

LAJITTELU SORTING

Puhdas ja kuiva pahvijäte *Clean and dry cardboard waste*

Tyhjät muovipakkaukset *Empty plastic packaging*

Vajaat kemikaalipakkaukset ja aerosoli
Chemical products packaging and aerosol

■ **Pahvi- / kartonkijäte** *Paperboard- cardboard waste*■ **Muovijäte** *Plastic waste*■ **Vaarallisten jätteiden keräykseen** *Hazardous waste collection*