

Saimaa University of Applied Sciences

Technology, Lappeenranta

Double Degree Programme in Civil and Construction Engineering

Civil Engineering

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DEMOLITION AND DEMOLITION WASTE IN SAINT-PETERSBURG, NCC'S POINT OF VIEW

Bachelor's Thesis 2015

ABSTRACT

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Demolition and demolition waste in Saint-Petersburg, NCC's point of view, 32 pages, 2 appendices

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Bachelor's Thesis 2015 instructors: Architect Martti Muinonen, Saimaa University of Applied Sciences; Project Engineer Ilya Mikhaylenko, NCC.

The purpose of the thesis was to accumulate knowledge about demolition and ecological norms in Russia and to show this knowledge on an example of Saint-Petersburg and Nordic Construction Company and make a hand book for foreign engineer in Russia with tips, rules and requirements.

Work in NCC gave an experience part of knowledge, how to cope with demolition and demolition waste on construction site and how to manage an ecological handling of the project. Consultation of the subcontractor's ecologist gave a lot of information in an easy-understanding form. To complete this thesis, both ecological and demolition requirements were studied from two points of view: government's and construction company's.

Most popular ways of demolition were considered. The best way for demolition in Saint-Petersburg was found according to conditions in the city. These studies permitted to make a work model and order of work for demolition legislation and process. The same was done for work with demolition waste and ecological work. During the making of this thesis some improvements were developed.

Keywords: demolition, demolition waste, ecological regulations, demolition regulations, Russia

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1. INTRODUCTION

1.1 General

The thesis work covers all aspects of demolition: demolition ways, demolition waste and legislations.

Demolition is the tearing-down of buildings and other structures. This definition is given in Wikipedia.

The main purpose of mankind action is to create something, not to destroy. Every new building or structure really has its proper place – place where this building is actual today. But nowadays it is a common situation when to build something new, some other things must be destroyed. In these cases demolition is irreplaceable.

Demolition has a lot of negative secondary influences: waste, noise, danger, air pollution with the dust. That is why so many norms and legislation about demolition exist. The biggest part of these norms is about demolition waste handling. Some years ago, mankind just threw away all waste, but now the situation has changed: all waste should be recycled, reused and only in some cases buried.

1.2 NCC in Saint-Petersburg

To get some experience and knowledge was started the practical training in Nordic Construction Company.

This company has started in late 1987 in Sweden, but now it works in Russia, Germany, Sweden, Finland, Estonia, Denmark, Norway, Latvia and others. NCC in Russia is represented by OOO NCC Real Estate. NCC Real Estate was founded in 2005 to have NCC's own projects, but for this time NCC had already built 83 buildings in Russia. Four big projects are realizing now, the fifth one will be started in the first quarter of 2016. More than six thousand flats are on sale right now.

2. DEMOLITION IN SAINT-PETERSBURG

2.1 Backgrounds, construction history

Saint Petersburg was founded by Tsar Peter the Great on 27 May 1703. Between 1713–1728 and 1732–1918, Saint Petersburg was the imperial capital of Russia. In 1918, the central government bodies moved from Saint Petersburg to Moscow. It is Russia's 2nd largest city after Moscow with 5 million inhabitants (2012). Saint Petersburg is a major European cultural center, and also an important Russian port on the Baltic Sea.



Figure 2.1 Narrow Shvedskii (Sweden) street

Due to long history of Saint-Petersburg and special architect style old districts of the city have very narrow streets and buildings are constructed “shoulder to shoulder”.

2.2 Environmental and ecological background

Saint-Petersburg is a very big city, so there are more than twenty waste landfills.



Figure 2.2 Waste landfill map of Saint-Petersburg

Here 1.5 million tons of construction waste are produced yearly. The government of Saint-Petersburg tries to reduce generation of waste. So, there are lots of laws, which regulate waste handling, especially for big organizations, like a construction company.

2.3 Demolition waste

During the demolition process a lot of waste is produced. Moreover, there are different types of waste with different class of hazard.

- Soils

Sometimes, together with dismantling of foundation and preparing of foundation pit big volumes of soils produced. So, on the first stage of Skandi Klubb construction, more than 40 000m³ of soils were produced.

- Recycle/repository/use

There are three ways of dealing with demolition waste:

Recycling is the best thing which could happen with that waste, which could not be used again. But, this is not easy, and it requires special plants. Unfortunately, in Russia it is still not popular way, because most of people and organizations are not ready to segregate waste and recycle plants would be unprofitable. At the moment only 8% (about 120 thousand tons) of construction waste recycle.



Repository is the oldest and the most popular way of work with waste. Waste is taken to a waste dump, which is suitable for this waste according to the hazard class and type of waste. The share of this way is about 39% (about 585 thousand tons of construction waste).



Figure 2.3 Waste repository

Use – in case of careful dismantling some sorts of waste could be reused many times, for example windows and doors, they could be placed to a new place. Clean soil could be used for recultivation. Thanks to big volumes of excavated

grounds, the share of this way is 53% (about 795 thousand tons of construction waste).



Figure 2.4 Reuse of grounds

- Problems and futures

So, the main problem is waste, the main aim is to reduce waste production. In local conditions (on construction site) it is not possible to make a waste recycle plant, but to segregate waste better, and use all materials many times if possible.

3. DEMOLITION REGULATION IN SAINT-PETERSBURG

3.1 Laws, regulation, authorities and permissions

This paragraph is about documentation and certificates for demolition and ways of getting it.

Lots of permits and licenses are needed to destroy a building or a structure:

- Certificate of ownership of a land and buildings situated on it.

According to Russian laws to demolish any object, the person must be the owner of this object or have a controlling interest.

To get this certificate, the owner of a land must apply to the registration chamber with the following documents:

- 1) Passport of an owner of a land
- 2) Survey plan, scale 1:500
- 3) Cadastral plan
- 4) Contract confirming ownership (buy/sell contract or rent contract)
- 5) Pre-paid state fee

Registration chamber needs 7-10 days to check this document, and after that issue the certificate of ownership.

- Cadastral plan and passport of the land parcel where an object situated (attested copy).

The next document, which is needed for demolition works is cadastral plan. If a land parcel already has a cadastral plan and passport, to get the cadastral plan, just apply to cadastral chamber.

Cadastral chamber issues these plans. The next steps needed to apply:

- 1) Fill in application
- 2) Pay state fee

Cadastral chamber needs up to 14 days to check this document, and after that issues the cadastral plan and passport. But if this land parcel does not have a cadastral plan and passport, the owner will have to apply to this cadastral chamber with lots of documents. There must also be a geodesic plan, made by a certified company.

- Cadastral passport of an object (attested copy).

To get a cadastral plan of land parcel is not enough. Cadastral passport of building is also needed. The order of getting cadastral passport for building is the same as the order of getting cadastral plan and passport of land parcel.

- Technical Inventory documents:

- 1) Plans for each floor
- 2) Legends
- 3) Technical passports (form 5 and 1a)
- 4) Cadastral passports
- 5) Extracts from cadastral and technical passports of an object.

Getting the above mentioned documents in Saint-Petersburg is possible in State Saint-Petersburg Unitary Enterprise “Urban government of inventory and real estate appraisal”. To apply the person must fill in an application and pay state fees.

- Site Plan.
- Company details. Included full name of a company, its address, telephone, bank details and government codes (INN, OGRN etc.)
- Verification letter from Committee on State Control Use and Protection of Historical and Cultural Landmarks about status of an object. Needed: Application letter to State Control Use and Protection of Historical and Cultural Landmarks and paid state fee.
- Owner’s order to demolish the object.
- Technical report of an object. Made by certified organization.
- Photo report of an object (at least 4 pictures for 1 object).
- Approximated in proper order demolition waste handling process description.
- Approximated in proper order plan of organization of work.
- Approximated in proper order layout of construction site.
- Certificates, agreements, job sequences about mechanical and electrical nets turnover.
- Traffic management project for period of demolition execution. This project must be designed together with demolition project and approximated in State Unitary Road Government.

- Project «List of measures for environmental protection» for period of demolition execution. This project must be designed together with demolition project.
- Subcontractor contract for demolition.
- Project of work outgoing, schedule of work.
- Contracts between contractor and waste landfill.
- Certificate of self-regulating company for demolition works.
- Contractor's company details. Included full name of a company, its address, telephone, bank details and government codes (INN, OGRN etc.)
- Approximated in proper order target specification for contractor

3.2 Demolition process

3.2.1 Norms and rules

There is a statement in Russia: “Ломать – не строить.” – that means demolition is much easier than construction. But in case of big buildings demolition is not easy, not fast, and it is a very dangerous process. So, Appendix 1 contains terms which could help any engineer to organize a demolition process, according to Russian statements, SNiPs etc. These terms also could be used as a checklist for an engineer to be sure that construction is going right and authorities are not going to assess the construction company for any violation.

3.2.2 Schedule

To prevent additional time and money spending, demolition must be included into the schedule from the very beginning. Let us check the way of use and direction of demolition of a new NCC construction site. There is an old metal rolling plant on the Ohta river bank. Now there are a lot of organizations working. So, to build on this site about fifteen buildings, two kindergartens, a school, and car parking, NCC has to demolish everything on this construction

site. So, NCC has developed a procedure for construction, demolition, office work, work of other organizations, and possibility of living for clients. To explain this idea, preliminary a scheme of construction site after finishing of the first construction order is added (Figure 3.1). The direction of the construction process is shown by blue arrows. NCC office is placed in the main building of the plant, and it will be there until the end of the construction (blue star). So, two buildings are finished already, and people already start living (green L) there, and NCC has already received money for the next orders of construction. On the next part of the site there is construction (blue C) going on. To clean the place for the next order demolition (orange D) is going on. But we still have place where companies work and pay rent to NCC. It is good for both sides: some additional money for NCC, and time for these companies to find a new place for work.

So, this example shows how to organize a big construction site, save time, money, and make all changes comfortable for customers, other organizations and for the construction company.

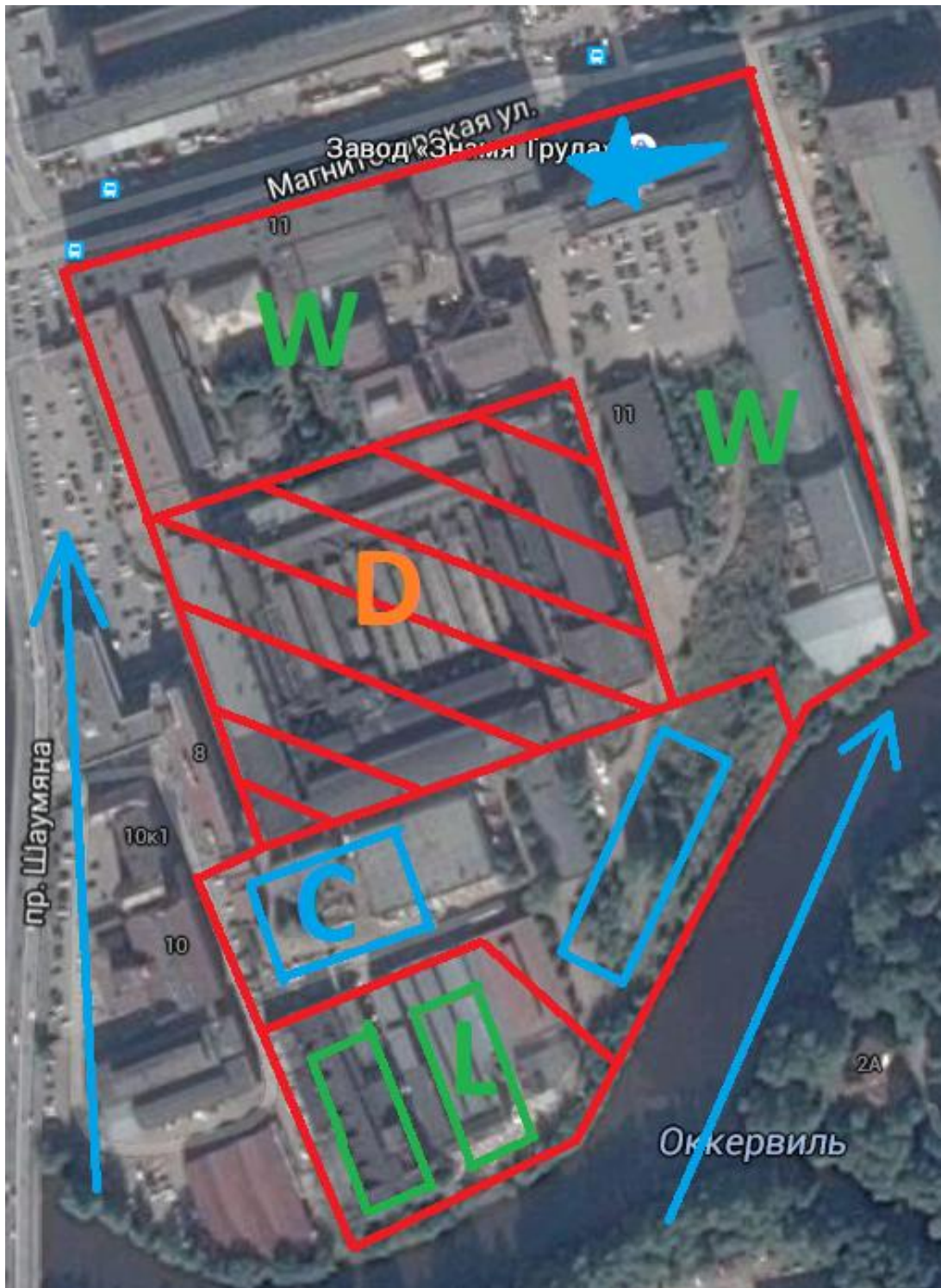


Figure 3.1 Preliminary a scheme of construction site after finishing of the first construction order.

3.3 Environment tips

NCC is an environmental friendly company, so the company sorts waste in a proper way. But we must also show it to government. That means a lot of paper

work, and the best decision for project engineer is to delegate all this ecological paper work to subcontractors. To delegate something does not mean to forget about it, but still control and manage all processes connected with the deal.

Let us consider NCC engineers' example of dealing with documents which any construction company must have to finish a construction process successfully:

- 1) Everybody who has to deal with waste 1-4 categories must have permit (license or certificate) for it. To get it engineers have to complete a training of 132 hours. Some colleges and universities offer these courses. So, this deal cannot be delegated and engineers must complete the course and have this permit.
- 2) Part of project documentation "Environmental control activity list". This part is reasonable to be delegated to subcontractors (architect) which develop project documentation. Project documentation including this part must be successfully inspected by special certified companies.
- 3) Waste Generation Standards and Waste Disposal Limits. According to order No 50 of ecological ministry, these Standards and Limits must be developed and inspected in Federal Supervision Service in Natural Resource Management. To do this work NCC has a contract with an ecological company.
- 4) Process description – this document is quite similar to Waste Generation Standards and Waste Disposal Limits, but it includes exact information about the types and values of waste and place of its placement. It must be developed according to order 1112RA and inspected in Natural Resources Committee.
- 5) Waste Passports 1-4 categories according to Federal Classificatory Catalogue of Wastes. Original information about wastes, attestation of waste attribution to certain category. Results of waste tests and biotestings. To get this data we need to make waste sample taking, tests, passports and inspect these passports in Federal Supervision Service in Natural Resource Management. It could be made by one or several ecological companies.
- 6) Information about installed treatment plants. Skandi Klubb construction site installed a special water treatment plant for car wheels wash. It gives a

possibility to save about 85% of water and reduce dirty discharge. NCC has delegated the installation of this plant to that subcontractor, who excavates the foundation pit and removes grounds by trucks. This way of delegation is good because responsibility for tidiness is given to that subcontractor which has most of the dirty work. They also must save all water treatment plant certificates, performance acts.

7) Performance acts and shipping documents which confirm fact of excavation and removing of grounds and waste. Subcontractors (excavation and transport companies) make these documents, but NCC have to collect them in a proper order unassisted.

8) Calculation of charges for the negative impact on the environment is always made by ecological companies. It must be paid four times a year for each quarter.

9) Bookkeeping and accounting in the area of waste handle. It is executed by filling in special tables according to Order of Nature Recourses Ministry No 721. It is usual work for ecological companies, so to delegate it to them is the best decision.

10) Record about industrial ecological control. NCC can do it unassisted to be sure that everything is clear on its construction site and with its documents.

11) Record about finish of urban landscaping according to project and inspected by Committee of Landscaping.

4. DEMOLITION

4.1 Demolition technologies in the world

General information about world demolition technologies as a wrecking ball, an excavator, an implosion and dismantle is placed in Appendix 2.

4.2 Popular demolition technologies in Saint-Petersburg

Due to historical low height of buildings in Saint-Petersburg, the most useful instruments are excavator and high reach arm. The necessity for this is that buildings in Saint-Petersburg are placed "shoulder to shoulder". Demolition of one building should be run as carefully as it is possible to exclude the possibility

of damage for other buildings. In Figure 4.10 you can easily see and understand why demolition in Saint-Petersburg must be so careful: the aim of demolition on this photo is to demolish a building with blue façade, but building with beige façade must stay safe.



Figure 4.1 Demolition in the city center

5. NCC AND DEMOLITION

NCC does not have any special policy about demolition, but the unspoken rule is exists. NCC does not destroy anything if it is not necessary. NCC tries to integrate new buildings into the city, not to replace. During the work on Scandi Klubb construction site, it was noticed that NCC does everything to save original trees and bushes which were here before.

During the work in NCC only two buildings were demolished.



Figure 5.1 Skandi Klubb Construction site before and after demolition.

Unfortunately, there is no photo of the demolition process, but information exists.

The yellow building was sport center near the stadium. With perimeter foundation (61,7 m³), brick walls (350 m³), reinforcement concrete slabs (80 m³), 9 windows, 17 doors, and six more types of materials.

The white building was a boiler house with living rooms for workers. With perimeter foundation (42 m³), brick walls (240 m³), timber walls (91,4 m³), timber beams and ceiling (75 m³), 13 windows, 10 doors, and six more types of materials.

All materials, all waste which were produced during the demolition of these buildings were sorted, and gotten away to suitable waste dumps. Actually, some waste dumps use waste or recycle it.

All demolition works were made by the subcontractor, including getting away of waste, and making ecological documentation about this work. The working plan was also made by the subcontractor organization. The general cost of these works was about 900 thousand rubles (about 13 thousand euros for 2015). The volume of this works was not big, so demolition was completed in one month. For demolition an excavator equipped with hydro hammer was used.



Figure 5.2 Demolition equipment on Skandi Klubb

In Figure 5.2 you can see an excavator equipped with hydro hammer. Usual bucket is placed in front of the excavator.

To demolish these two buildings, were made all the above mentioned things with authorities. So there are no cultural and architectural monuments.

As it was mentioned before, NCC does not destroy anything if it is not necessary.



Figure 5.3 Skandi Klubb plan

In Figure 5.3 you can see the plan with future buildings, and two buildings, which were demolished.

These two buildings were placed on the future place of the second construction stage of Skandi Klubb. Two old buildings will be replaced with residential compound of 350 apartments with green zones, sport facilities, big underground parking, a shopping center and a kindergarten.

6. CONCLUSION

Demolition always means additional expenses. Demolition always extends the construction schedule. Demolition is a noisy and dangerous process. But only

demolition could give today's engineers the opportunity for use of land more effectively than engineers did it in the past. From the business point of view construction in a city center is more profitable than anywhere else. So demolition cleans the place for new profitable projects. The aim of engineers is to find the best way to cope with this process. So, engineers should always look forward and make a plan of the construction site and schedule as rationally as it is possible (follow NCC's example in chapter 3.2.2). Before buying a site, the engineer should be sure that this site is suitable for the project, that all buildings which are situated there could be demolished (check in local authorities), and that the roads are suitable for trucks according to police and fire norms. Do not rush and make all decisions with one hundred percent sure. A Russian statement says measure seven times, cut ones.

During my work on this thesis, I have got a new idea about the use of waste: our company pays for transportation of waste and repository of it. But in some cases waste could be used again (clean soils for example), and waste dump resells this waste to other companies, which needed this material. So, why does not NCC turn waste into a product and find a client for this product? My idea has been approved by the general director, and I have started my own research in ecological sphere about this question.

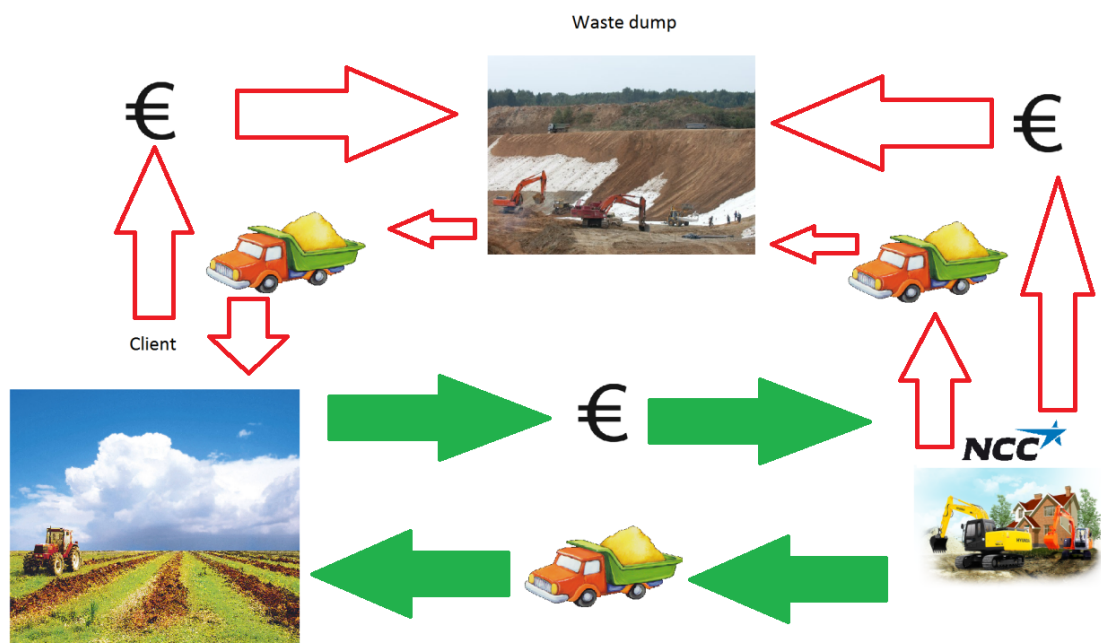


Figure 6.1 Scheme of my idea

In Figure 6.1 you can see my idea about waste handling. Present situation is described by red arrows (empty ones), and future situation is described by green arrows (full ones).

I hope my work will help some engineers to cope with demolition and secondary influence of demolition.

Figures

Figure 2.1 Narrow Shvedskii (Sweden) street

Figure 2.2 Waste landfill map of Saint-Petersburg

Figure 2.3 Waste repository

Figure 2.4 Reuse of grounds

Figure 3.1 Preliminary a scheme of construction site after finishing of the first construction order.

Figure 4.1 Demolition in the city center

Figure 5.1 Skandi Klubb Construction site before and after demolition.

Figure 5.2 Demolition equipment on Skandi Klubb

Figure 5.3 Skandi Klubb plan

Figure 6.1 Scheme of my idea

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Appendix 1 Demolition process rules

1 General provisions

1.1 Decisions and actions for the organization of demolition of buildings and constructions are developed in the project documentation which is a project part of the organization of works on demolition of objects capital the construction according to point 5.7.1 of the SP 48.13330.

1.2 Territory of a building site and sites of works are subject to a protection with installation of signs of safety, according to point 1.1 of GOST 23407, GOST P 12.4.026.

1.3 It is necessary to notify all on terms of the planned collapse of object working at a building site, and also the organizations operating adjacent territories, according to point 6.9.3 of the SP 48.13330. If necessary the cordon is exposed.

1.4 Before demolition of buildings and constructions examination of technical condition of designs of object for the purpose of establishment is conducted:

- dangers of a collapse of designs;
- possibilities of a reuse of designs;
- safe production of demolition and reconstructive works.

2 Preparatory activities

2.1 Solutions of organizational and technological documentation have to provide: justification of a method of elimination of object, definition of sequence of works, establishment of dangerous zones and zones of warehousing of products of dismantling, temporary fixing or strengthening of designs for prevention of their collapse, methods of protection and justification of use of protection devices of engineering networks, security measures at demolition or dismantle of buildings and constructions, actions for environmental protection according to point 6.9 of the SP 48.13330,

to the Construction Norms and Regulations point 4.1.3 12-04.

2.2 Specified in 2.1 decisions have to contain actions for the prevention of impact on workers of dangerous and harmful production factors:

spontaneous collapse of designs and elements of object, falling of loose designs and the equipment, moving parts of construction cars and freights moved by them, sharp edges of designs and the sticking-out cores, the raised content in air of a working zone of dust and harmful substances, a workplace arrangement near difference on height of 1,3 m and more according to point 4.1.1 of Construction Norms and Regulations 12-04.

2.3 The construction organization which is carrying out demolition or dismantle of object

has to receive the document certifying blackout, gas pipelines, steam lines, water supply systems, air ducts, and also all communication systems, the automated and remote control technologists of the chesky equipment at the technical customer. This document has to contain the conclusion about permission to perform works, the characteristic of networks and their design.

2.4 Shutdown of engineering networks is made by the organization under which authority these networks, with registration of the relevant documents are.

2.5 The scheme of temporary power supply for demolition of the building, a construction has to be independent of the existing scheme of an electrical wiring of object.

2.6 The person allowed to elimination of object has to:

- to get permission for demolition of object at the technical customer;
- to receive the documents certifying shutdown of communications at the technical customer;
- to issue the order on the organization defining a works order on a building site in each change;
- to appoint responsible for works, fire safety, electrical safety.

The plate with surnames of responsible persons is hung out on the construction to platform in a visible place site of works.

The relevant orders have to publish the subcontract organizations involved in performance of work.

3 Dismantle of the equipment, internal engineering systems and finishing elements

3.1 Before demolition of object the technological is dismantled and special equipment, instrumentations and automatic equipment, engineering systems – the engineering equipment, sanitary networks, systems of power supply, communication, radio and television.

3.2 Dismantle of the processing and special equipment

3.2.1 Before dismantling works it is recommended to carry out the repeated and to specify survey of the processing and special equipment accepted re-sheniye.

3.2.2 The processing and special equipment which is subject to dismantle and being in an assembly zone is disconnected from all engineering systems.

3.2.3 First of all the works which aren't need the fire cut are performed.

3.2.4 It is necessary to start fire cut works only after check

the technical customer of performance of work on preparation of the equipment for dismantle (3.2.5, 3.2.6).

3.2.5 Raising of the dismantled equipment or its joints is carried out only after removal of all fasteners, detachment of the technological pipelines and removal of instrumentations.

3.2.6 Before dismantle of equipment installed on the reinforce concrete bases, it is necessary to raise (to separate) it over the base with the help jacks or wedges (Construction Norms and Regulations 5.02.02).

3.2.7 The mass of the lifted equipment or its part has to correspond to parameters of the bridge crane and its lifting equipment. For land cranes such weight shouldn't exceed a half of loading capacity of the crane at the greatest departure of an crane jib.

3.2.8 In the course of demolition works it is necessary to conduct continuous supervision over stability of the remained not dismantled elements.

3.2.9 In fire dangerous buildings and rooms demolition works are carried out on permission of administration and coordination with fire and gas rescuing services.

3.2.10 Works with the fire cut are carried out only after cleaning from flammable and explosives objects in a radius not less 10 m with necessary ventilation.

3.2.11 Dismantling works in rooms (shops), for a gas contamination exception, are carried out by assembly cranes with electric engines.

3.2.12 Operation of bridge cranes is limited within a working zone with installation of trailer switches and a temporary adjustable stop.

3.3 Demolition of internal engineering systems and elements of finishing

3.3.1 Internal engineering systems of water supply, water disposals, gas supply, power supply, heat supply, ventilation and communications, including the engineering equipment and devices are had to be dismantled and sorted in proper place.

3.3.2 Dismantling of systems of power supply begins with removal of the lighting devices and electric boards. Then wires in boxes and internal are dismantled channels with the subsequent their coiling.

3.3.3 Metal pipes of engineering networks are cut and transferred on place of temporary storage.

3.3.4 Window frames with a glazing are removed from its frames and are transferred on

place of temporary storage where over the container make office of glass.

3.3.5 Doors are removed from loops and are transferred to a platform (room) of temporary storage. There the removed window and door frames are transferred.

3.3.6 On a building site in a zone of materials warehousing heavy-load containers separately for a tree, linoleum and plastic, sanitary products, electro products, glass, metal are installed in which materials are storage and transported a building site for utilization.

4 Ways of demolition of buildings and constructions

4.1 Ways of demolition of buildings and constructions and their designs include:

a) the mechanical;

b) the explosive;

c) the special:

1) the hydro explosive;

2) the thermal;

3) the electrohydraulic;

4) way of hydro splitting.

4.2 Mechanical collapse of object

4.2.1 The mechanical collapse provides to a falling of buildings by the excavator with hinged equipment – a wrecking ball.

Breakdown of the escaped designs on part can be carried out by jackhammers.

4.2.2 At demolition with using of wrecking ball it is necessary:

- to define a safe zone of work a wrecking ball;
- to establish on borders of a dangerous zone temporary protections and signs of safety, and also alarm lighting in dark time. At impossibility establishments of temporary protections along all dangerous zone are established protective nets or boards for prevention of hit of splinters of designs and materials in a safe zone;
- to establish an excavator arrow at an angle not less 60° to the horizon;
- to establish a protective protection (grid) on excavator cabin glass.

4.2.3 The safe zone of a wrecking ball work is determined by range of scattering of the destroyed material pieces at different angle of a wrecking ball hitting by the table 1.

Table 1 - The safe zone of a wrecking ball work

Ratio of breaking ball weight(kg) to height of building(m)	Range of scattering of the destroyed material pieces(m), with angle of a wrecking ball hitting:			
	80°	75°	70°	65°
1500/3,3	10	17	27	39
2500/3,5	10	18	33	42
3500/4,0	11	18	33	47
4000/4,5	13	23	40	57

4.2.4 Hits of wrecking ball are struck by its deviation from the vertical position before initial situation, according to technical data list.

It is forbidden to hit due to turn of an arrow.

4.2.5 The distance from the excavator to the destroyed design has to be not less than height of a building (for 2 – 3 floor buildings).

4.2.6 Vertical parts of an object must collapse inside structure for prevention of fragments dispersion across the territory.

4.2.7 Demolish fragments in process of their production are moved aside by bulldozers

or loaded into vehicles for export from the construction site to a waste landfill.

4.2.8 For demolition of one or two floors buildings the hydraulic excavators providing possibility of control of the destroyed elements falling direction are recommended.

4.2.9 For 5 floors panel buildings it is expedient to apply to demolition excavators with universal hydraulic tongs.

4.2.10 For demolition of panel or monolithic buildings up to 25 m high use excavators with hydraulic or mechanical scissors is recommended.

4.2.11 For demolition of buildings, constructions up to 60 m high, application of the special excavators destroyers with weight from 150 t equipped with hydraulic scissors.

4.3 Explosive way of a demolition

4.3.1 Explosive works are performed for demolition or crushing stone, concrete and reinforce concrete structures.

4.3.2 Demolition of the basement by explosion is carried out as on opened, cleaned from structures building sites, and inside buildings.

4.3.3 The object demolition is made in the explosive way on its basement or in the set direction according to organizational and technological documentation.

4.3.4 The building demolition on its basement must form of demolitions width which isn't exceeding $1/3$ heights of object.

4.3.5 Demolition in the set direction is used in high-rise constructions (towers, chimneys, etc.) which height four times and more exceeds the section dimension.

4.3.6 The building demolition on its basement is made by charges in the shots placed from the inside of the building in two ranks in chessboard order.

4.3.7 Diameter of shots is from 40 to 60 mm, and depth – 2/3 thickness of a wall. The distance between shots is from 0,8 to 1,4 and between ranks – from 0,75 up to 1,0 depths of the shot.

4.4 Special ways of a demolition

4.4.1 Special ways of object demolition: hydro explosive, thermal, electrohydraulic and way of hydro splitting.

4.4.2 The hydro explosive way is applied to destruction of designs of a box-shaped form, tanks, etc., and also stone, concrete and reinforce concrete construction. Difference of a hydro explosive way from an explosive way is filling of free space of shots with water or clay solution.

4.4.3 The thermal way is effective at demolition of monolithic concrete and reinforced concrete structures. Thermal sharp of structures is made with use of a powerful source of heat in the form of a high-temperature gas stream or an electric arc. The principle of action of this way is in concrete melting by products of combustion of iron in a stream of the oxygen coming to a combustible pipe in the sufficient quantity for burning and carrying out of slag from the cut structure.

4.4.4 The electrohydraulic way is applied to demolition of monolithic concrete and stone laying. Electrohydraulic way advantage is lack of a blast wave and scattering of splinters and safe for the people working close and the installed equipment.

4.4.5 The way of hydro splitting is used for demolition of monolithic concrete and brick structures in the constrained conditions. The way of hydro splitting is based on application hydraulic splitter, representing pin up devices with hydraulic cylinders. For demolition of an object hole is drilling. Hydraulic cylinders are put into this hole and pin up. As a result the effort developed by a hydraulic cylinder increases several times. Demolition of an object happens silently and without scattering of pieces and splinters.

Appendix 2 Demolition technologies in the world

1 Excavator

For small buildings, up to three stories high, demolition is going with using of excavators with special hydro hammers and with usual buckets. That is enough because process of demolition is rather simple in this case. Idea of this demolition technique is to let building parts fall in proper direction and in proper time. If any part fixed for a full due, hydro hammer solve this problem.



Figure 1.1 Excavator

1.1 High reach arm

The same method could be used if a building is higher. But in this case special equipment used which allow to reach points 40 meters high. It could also be equipped with hydro hammer, but for safety buckets changed with special arm,

which could take parts strong and drop it directly in proper place.



Figure 1.2 High reach arm excavator

2 Wrecking ball

This method commonly used in masonry buildings. To demolish building with this method crane and iron ball which could weigh up to four tons. Crane swings the ball and hit a demolition object. This method has a really big disadvantage: the ball could become uncontrolled and hit anything beside the demolition object. Debris of masonry could fly away and it also dangerous.



Figure 2.1 Demolition with wrecking ball

3 Implosion



Figure 3.1 Implosion demolition

This is the most impressive demolition method. Implosion is a violent bursting inward that allows the sequential elimination of structure supports. Implosion demolition methods are used in urban areas and often involve large structures.

This method really useless in Saint-Petersburg's conditions.

4 Dismantle

But what about the most modern solutions in demolition? If you need to save construction elements, dismantle of construction needed. Dismantle of low buildings is easy to execute. But how to dismantle tall buildings?

Japanese engineers of Kajima Corporation have developed and used new method of dismantle for tall buildings:

“The Kajima Cut and Take Down Method”



Figure 4.1 The Kajima Cut and Take Down Method

In April 2007, Kajima started development of a pioneering demolition method when we decided to dismantle our former head office buildings (75-meter tall/20 stories, and 65-meter tall/17 stories).

1 Cut the column

Cut length of 70cm for a column and take off



Figure 4.2

2 Extend the jack stroke

Extend length of 70cm for jack stroke



Figure 4.3

3 Take down all jacks

After doing from (1) to (2) process for all columns, we take down all jacks



Figure 4.4

4 Take out beams and floor slab of the next upper floor



Figure 4.5

KAJIMA CORPORATION

This method very nice for environment, but if the aim of a project is to develop something new, demolition is the best option especially if you have to do it fast.