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Concept of Expansion of Rolling Stock Repair and Operation Section in Sochaczew



 <p>Koleje Mazowieckie</p>	<p>Concept of Expansion of Rolling Stock Repair and Operation Section in Sochaczew</p>	<p>VISSYSTEMS Design and engineering</p>
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Study Data Sheet

<p>Title of Study:</p>	<p>"Concept of Expansion of Rolling Stock Repair and Operation Section in Sochaczew".</p>	
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INTRODUCTION.

Study Objective and Scope

The subject of this study is the "Concept of Expansion of Rolling Stock Repair and Operation Section in Sochaczew". It covers the final variant of the construction of the maintenance facility without the bogie repair room. The inspection room where the P1-P3 maintenance level inspections are presently carried out for the rolling stock assigned to the Rolling Stock Repair and Operation Section in Sochaczew will need to be reconstructed.

Basic concept assumptions:

- optimised use of technical back-up facilities of the section,
- optimised use of the available site for the needs of planned inspections and repairs and the social facilities.

1. GENERAL INFORMATION

The study has been produced based on observations made in the Rolling Stock Repair and Operation Section in Sochaczew and the information gathered during the working meetings with the representatives of Koleje Mazowieckie. Figure 1 presents plots of land acquired for the development projects 1, 2, 3, 4, 5, 6 and plot 7 – a water ditch.

Coal dump to be demolished in order to provide space for a new full train washing facility, an ice protection station and an area for sidetracks.

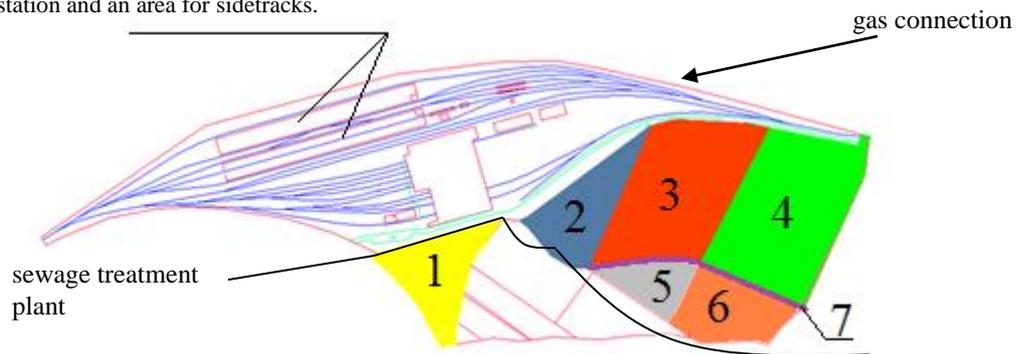


Fig. 1. The site of the existing Rolling Stock Repair and Operation Section in Sochaczew along with the plots of land acquired for the development.

The study takes the purchased plots 1, 2, 3, 4, 5, 6 and plot 7 (in acquisition) into account and they make up the area for which the final concept of development of the existing Rolling Stock Repair and Operation Section in Sochaczew, enabling to carry out P4 maintenance level repairs of 50 to 75 vehicles of various types per year and P1 - P3 maintenance level inspections, has been assumed.

It has been assumed that repairs of bogies will be carried out by external service providers.

It is necessary to move the water ditch from plot 7 to the edge of plots 5 and 6.

2. EXPANSION OF EXISTING SOCHACZEW SECTION TO ENABLE P1 - P4 MAINTENANCE LEVEL INSPECTIONS OF ROLLING STOCK

2.1 Current Condition

The following works were completed at the Rolling Stock Repair and Operation Section in Sochaczew In the recent years: service pits were inspected and lighting was installed, repair station rooms and drive-through vehicle washing facility were renovated. Unfortunately, since vehicles must be washed also in the winter season, this operation is carried out in the inspection room which makes the inspection process much more difficult and disorganised, let alone the detergents and soapy water left after the cleaning of the vehicle Therefore, in the accepted variant, it is require to demolish existing coal dumps (Fig.1) to provide area for the construction of a full train washing facility and an ice protection station and to plan area for sidetracks.

2.2. Expansion of Existing Rolling Stock Repair and Operation Section in Sochaczew for Continued Delivery of P1 - P3 Maintenance Level Inspections

Considering the location, number of tracks, number and length of stations in the existing inspection and repair room, the current technical condition and the personnel, the P1-P3 maintenance level inspections should continue to be provided within the area of the existing Section.

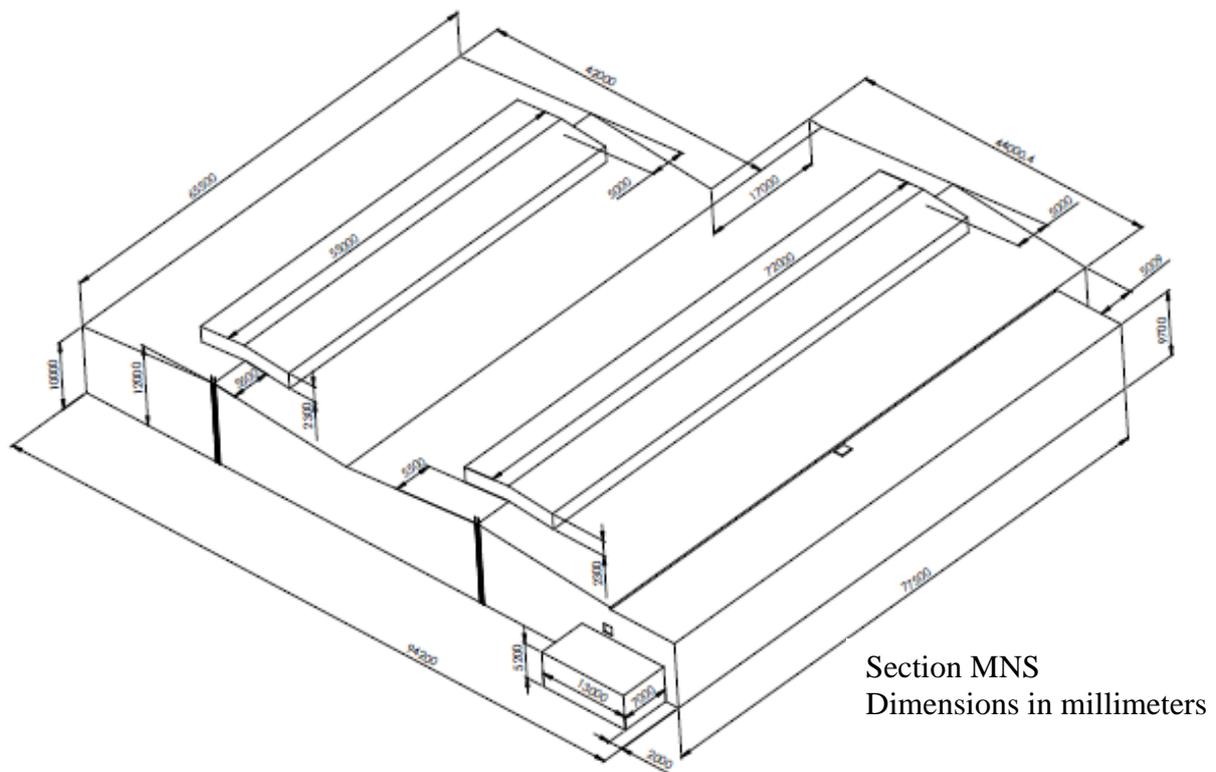


Fig. 2. Rolling Stock Repair and Operation Section in Sochaczew - view of the Inspection and Repair Room building structure.
(Source: Koleje Mazowieckie.)

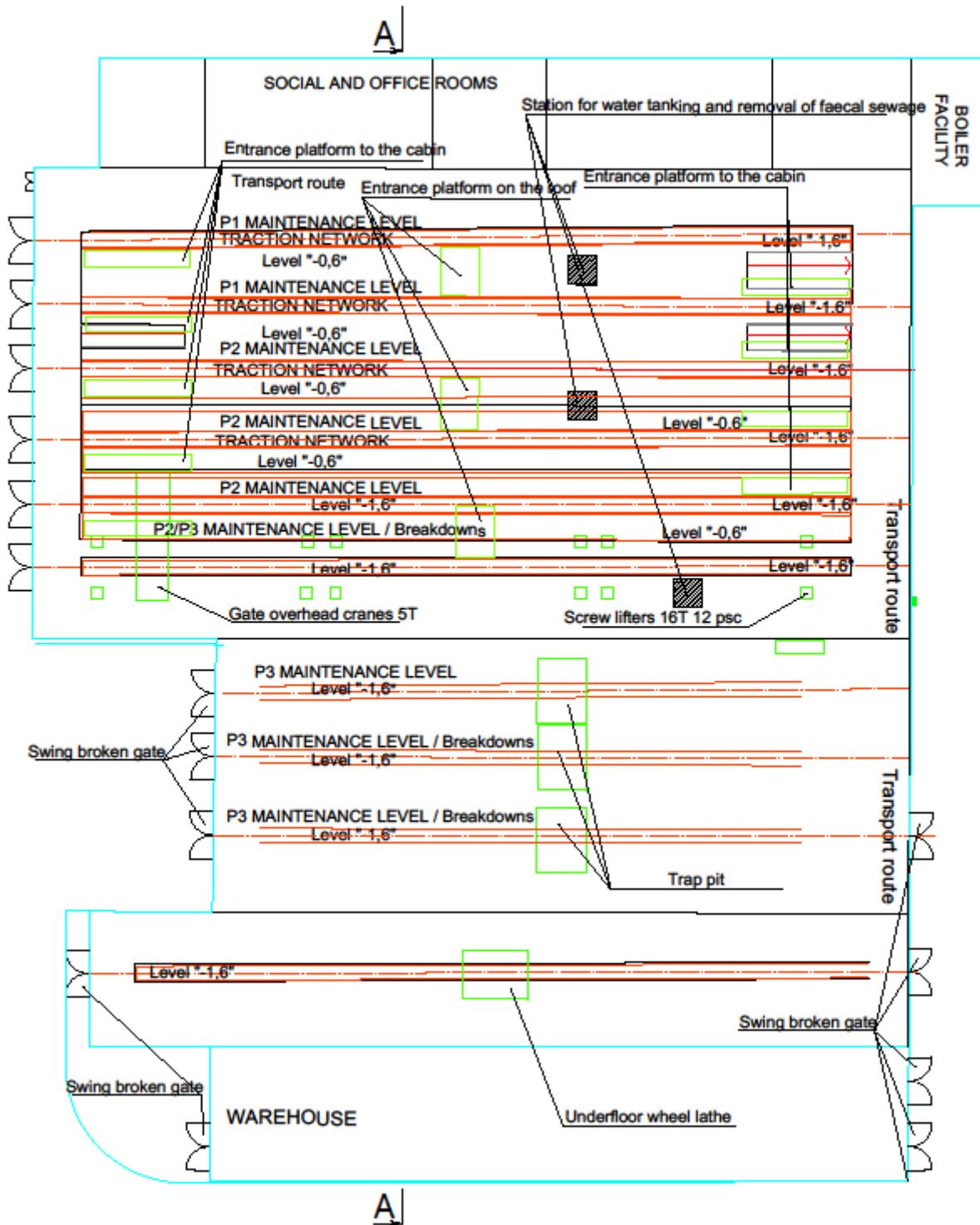


Fig. 3. Rolling Stock Repair and Operation Section in Sochaczew - Cross section of the existing inspection and repair room with proposed stations.

(Source: (Independent study by VIS Systems))

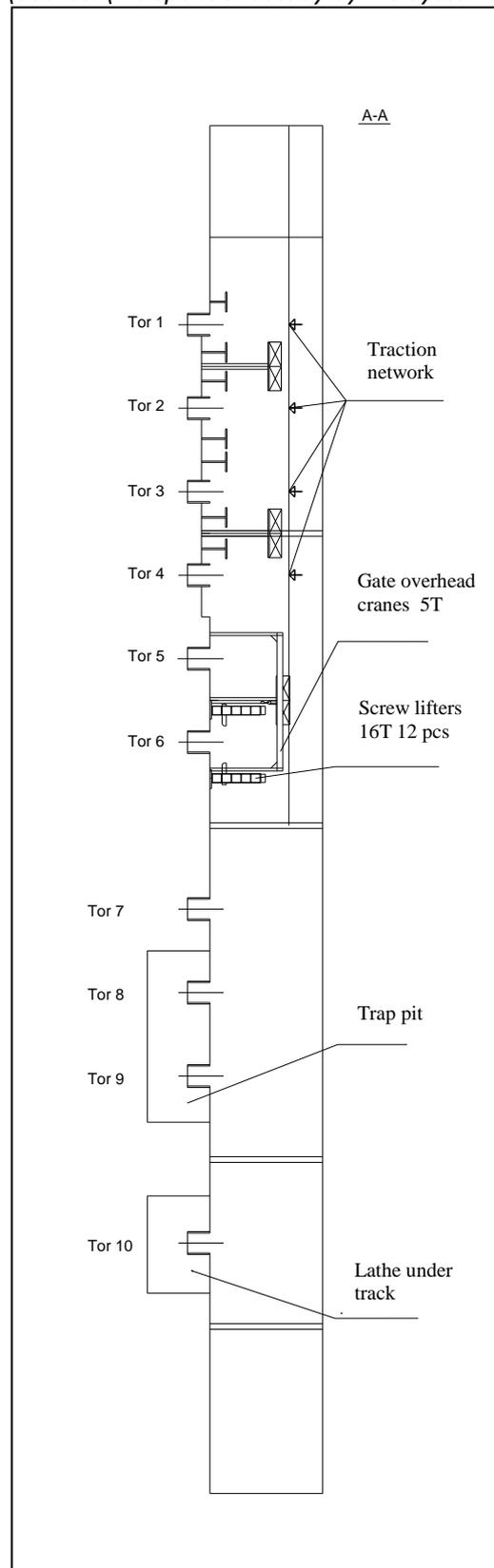


Fig. 4. Rolling Stock Repair and Operation Section in Sochaczew - Cross section of the existing inspection and repair room with proposed stations.

(Source: (Independent study by VIS Systems)

Scope of works in the Section

P1 Maintenance Level:

Check-up operations or monitoring carried out before the railway vehicle sets out on a journey or after it has finished its journey. Some of these operations should be carried out by the carrier's personnel (engine driver, overseer) or by means of automatic on-board or track-side device.

Framework scope of works:

- Assessment of the technical condition of assemblies, subassemblies and systems of the railway vehicle which determine the vehicle motion safety,
- Supplying the railway vehicle with consumable materials,
- Replacing of fast wearing elements if necessary when worn.

P2 Maintenance Level:

Operations preventing the maintenance limits from being exceeded, carried out at specialised stations during breaks between the periods of planned operation of the railway vehicle.

Framework scope of works:

- Detailed assessment of the technical condition of the railway vehicle by checking the performance of its circuits, visual inspection of subassemblies which are accessible without being removed, diagnostic tests as planned according to the documentation,
- Making necessary measurements,
- Repairs carried out by replacing standard elements.

P3 Maintenance Level:

Operations preventing the maintenance limits from being exceeded, carried out at specialised stations, involving planned withdrawal of the railway vehicle from operation.

Framework scope of works:

- Detailed assessment of the technical condition of the railway vehicle by checking the performance of its circuits, also visual inspection of subassemblies accessible after being removed as specified in the documentation and diagnostic tests as planned according to the documentation,

- Planned replacements of subassemblies and small repairs of functional assemblies and subassemblies carried out at specialised stations.

The section should be equipped with the following stations, utilities and infrastructure:

- Automatic station for geometric measurements of wheel sets and bogies,
- set of measuring devices for geometric measurements of wheel sets and bogie with the measurement registration option,
- Portable station for water tanking and removal of faecal sewage from the vehicle,
- Mobile two-level inspection platforms for side walls and roof,
- On-hand warehouse of fast wearing spare parts and consumable materials.

Depending on the results of geodetic measurements, it may be necessary to rebuild tracks in the inspection room.

2.3 Design of extension of the existing Rolling Stock Repair and Operation Section in Sochaczew P1-P3 maintenance level inspections and P4 maintenance level repairs of 50 to 75 vehicles of various types (excluding the bogie shop).

2.3.1 General information.

To carry out the project, plots 1, 2, 3, 4, 5, 6 have been acquired and the acquisition of plot 7 is underway. This variant includes carrying out P1-P3 maintenance level inspections of vehicles assigned to the Rolling Stock Repair and Operation Section in Sochaczew and P4 maintenance level repairs of 50 to 75 vehicles of various types every year.

The specific location of the repair room makes it necessary to find a new location for the oil tanks (Fig. 5).

Considering the necessity to interconnect the track system of the inspection room and the repair room, in the variant being considered, the workshops have been removed from the area where the tracks are planned to be built.

The new system of tracks also requires demolishing a residential building which exists within the Section site.

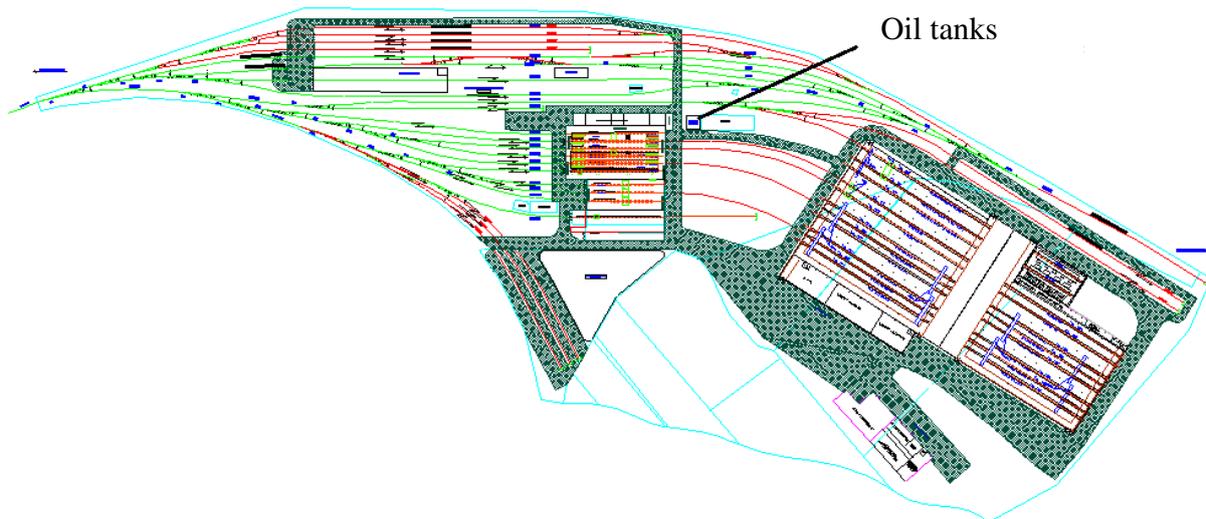


Fig. 5. System of tracks with the planned development of the site.
(Source: independent study by VIS Systems)

This design is an optimised one with regard to the available site which can be used. It includes an expanded inspection room for P1 - P3 maintenance levels and a vehicle box repair room with a traverser installed inside the room which divides it into to aisles. The first (long) aisle is designed for the P4 maintenance level repairs of five-module vehicles and the other (short) is designed for four-module and three-module vehicles. Other vehicles will be repaired in both aisles. The detailed layout of the individual inspection and repair rooms with their equipment and distribution of stations is presented below.

2.3.2 Inspection Room for P1-P3 Maintenance Levels.

The inspection room for P1 - P3 maintenance levels will be located in the existing expanded room of the Rolling Stock Repair and Operation Section in Sochaczew, described in item 2.2.

2.3.3 Car body repair room for P4 maintenance level repairs with repair workshops, paint shop and traverser.

2.3.3.1 Car body repair room for P4 maintenance level repairs.

The layout of repair stations, warehouse rooms and repair workshops are presented below.

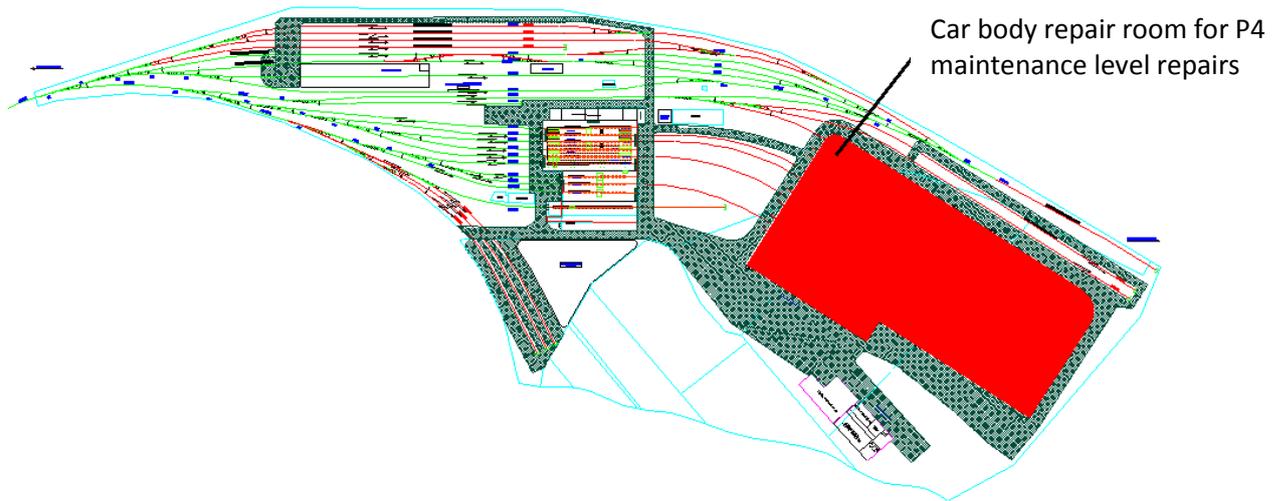


Fig. 9. System of tracks and site development - car body repair room for P4 maintenance level repairs with repair workshops and traverser.
(Source: independent study by VIS Systems)

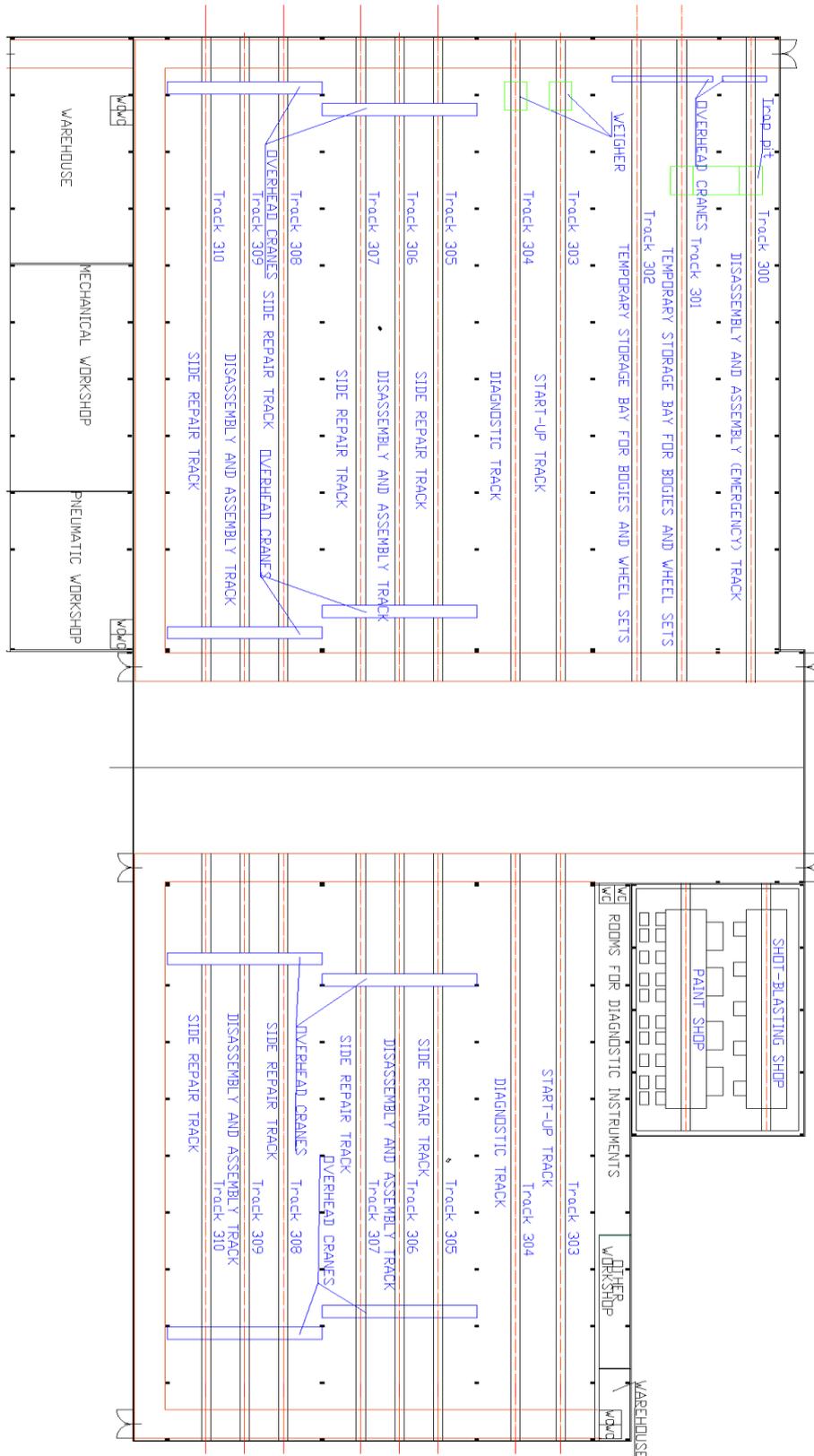


Fig. 10. Car body repair room for P4 maintenance level repairs with repair workshops and traverser.

(Source: independent study by VIS Systems)

The car body repair room is equipped with 11 tracks on which vehicle boxes are repaired at the P4 maintenance level.

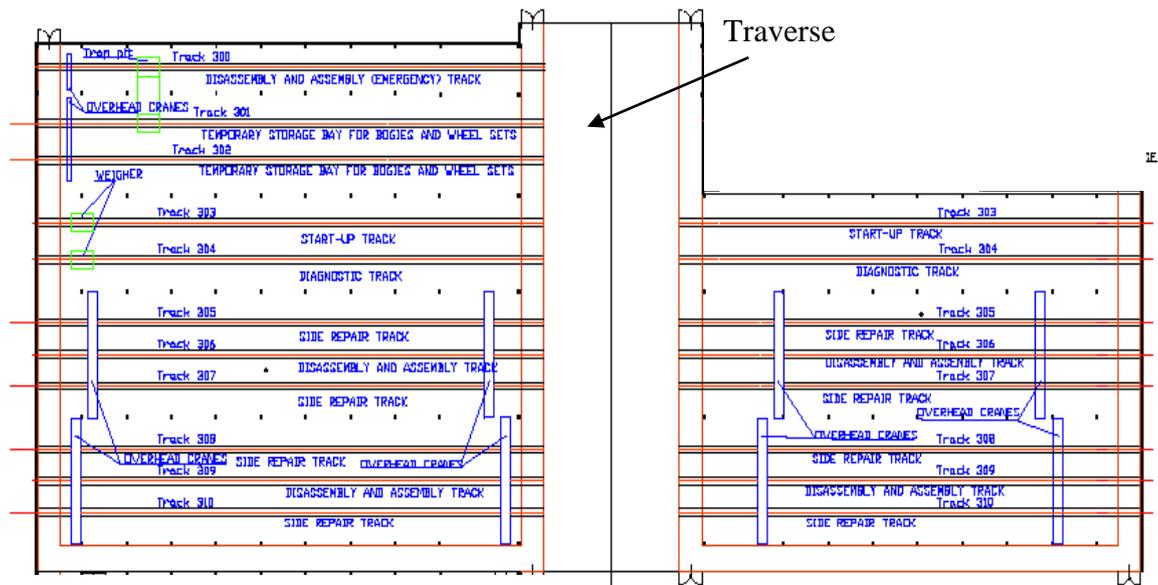


Fig. 11. Car box repair stations for P4 maintenance level repairs with the traverser.
(Source: independent study by VIS Systems)

Subassemblies and devices located in the vehicle box are dismantled and installed with the use of two tracks inside the repair room, both in the part designed for five-module vehicles and for three- and four-module vehicles (Fig. 12).

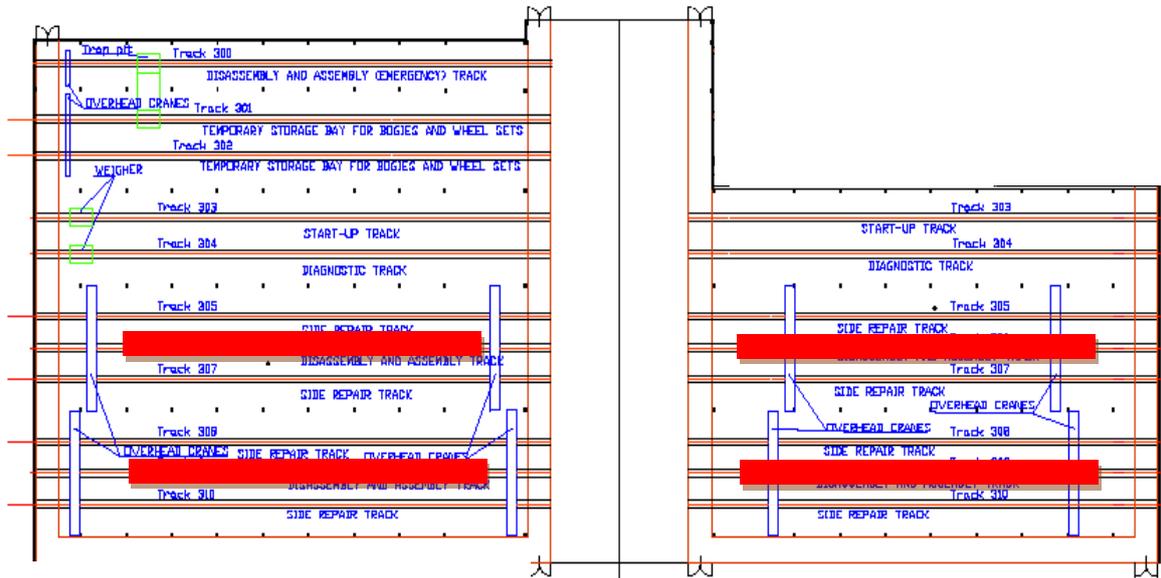


Fig. 12. Highlight of disassembly and assembly stations
(Source: independent study by VIS Systems)

These tracks are also used to disconnect modules of the vehicle and to separate the box from bogies. The disassembly and assembly stations will be equipped with mobile screw lifters, each with the load capacity of 16 ton, ready to be readjusted to fit each kind (each length) of the vehicle. These will be 20 lifter units for five-module vehicles and 16 lifter units for three- and four-module vehicles.

After disassembly or assembly of a vehicle, lifters can be removed to a temporary storage bay, thus providing free space for the overhead cranes to operate.

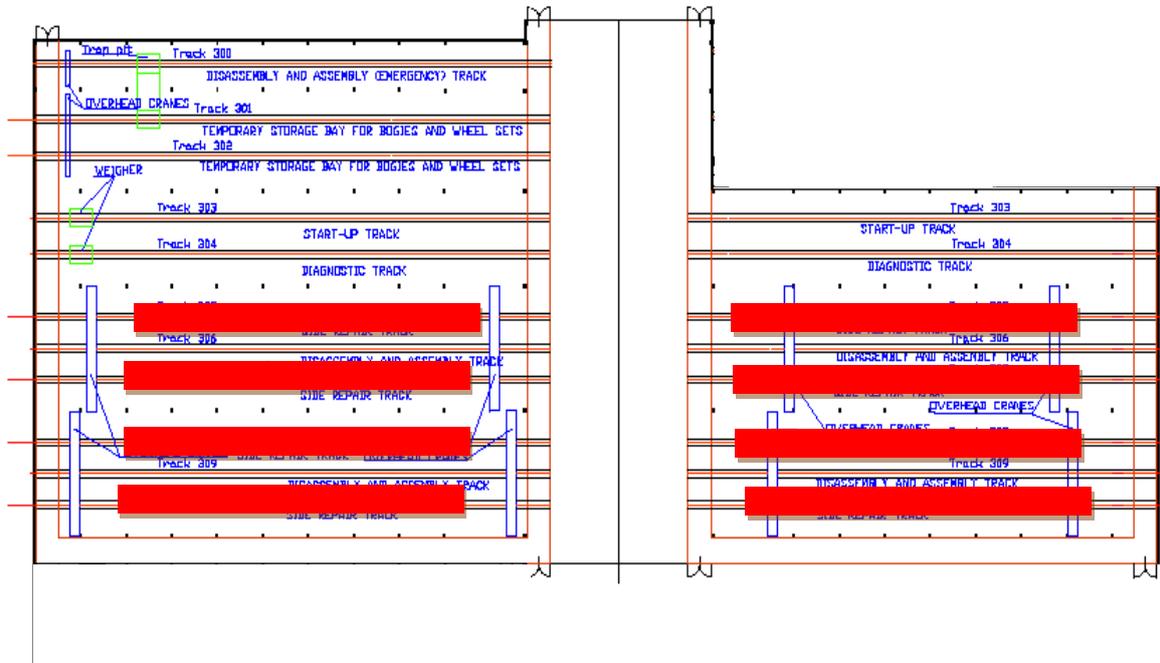


Fig. 13. Highlight of repair stations
(Source: independent study by VIS Systems)

The repair stations (Fig. 13) are located in two aisles. The stations will be used to dismantle all devices from the vehicle box, clean and repair the entire interior, including linings, repair or replace damaged wire harnesses, repair or replace damaged elements of the pneumatic system and install the devices after repair. Apart from dismantling and installing the devices, the stations will also be used to carry out box repairs such as straightening or replacing brackets, replacing corroded or damaged parts of the sheathing.

The repair stations will be provided with tracks in the room without pits. Each repair aisle will be equipped with four overhead cranes, 30 ton lifting capacity each. Boxes will be transported to repair stations by means of overhead cranes. Such means of transport and temporary storage racks will allow freely arranging the free space on both sides of the vehicle as necessary. The engineering carriages will allow moving the vehicle box along the room without having to use the overhead crane. Racks of different heights will allow to carry out works under the box (high racks) as well as inside and outside of a vehicle (low

racks - access from level "0"). Stations will also be provided with mobile platforms with adjustable height.

The start-up stations and diagnostics stations are located on two tracks of the repair room (Fig.14).

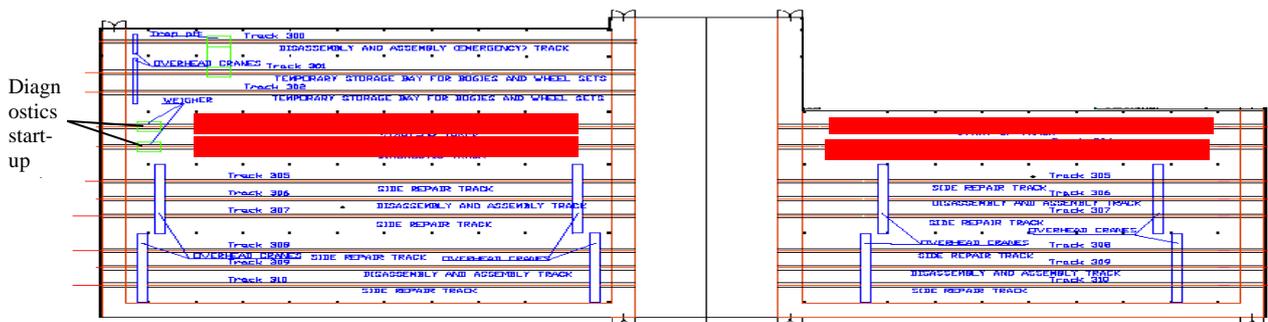


Fig. 14. Highlight of the start-up and diagnostics stations
(Source: independent study by VIS Systems)

The start-up stations will be used to carry out diagnostic tests of a complete vehicle after its all subassemblies have been repaired, cooperation of the vehicle modules and commissioning of performance and cooperation of all subassemblies by the authorised personnel. Apart from the diagnostics of the vehicle internal systems, both at the diagnostic station and the start-up station, the vehicle balancing will be checked and adjusted if necessary (Fig. 15).

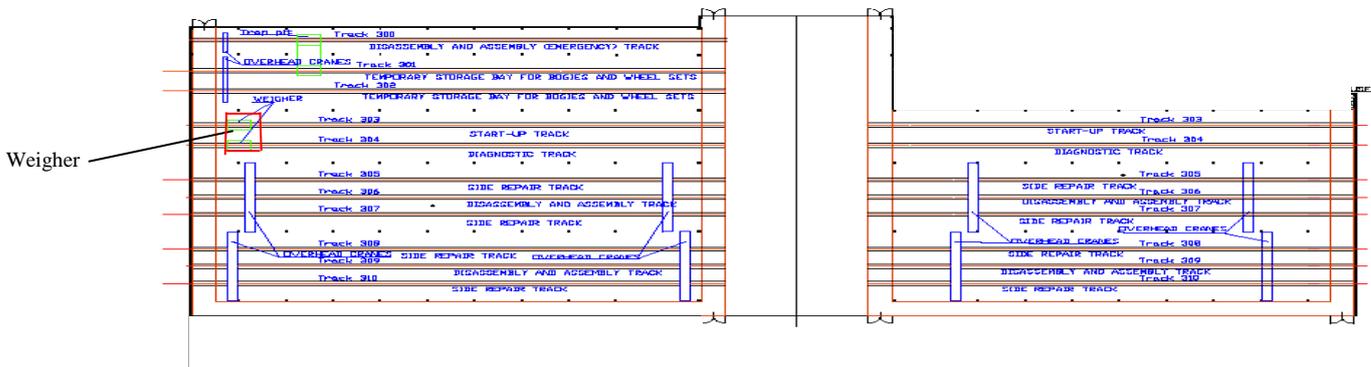


Fig. 15. Highlight of weigher stations
(Source: independent study by VIS Systems)

The start-up stations will be equipped with mobile platforms for checking the subassemblies installed on the roof of a vehicle, 20 mobile screw lifters and a weigher for checking the balancing of the vehicle.

The screw lifters will be used if the balancing of the vehicles has to be adjusted.

After the vehicle has been repaired and initially commissioned, it will go through the existing P3 room to a holding track station where it will wait for test start-ups.

The disassembly and assembly station designed for emergency repairs can be accessed directly from the side track. This station will also be provided with a trap pit to enable replacement of a wheel set or a drive unit and a 5 ton capacity overhead crane (Fig. 16 and 17).

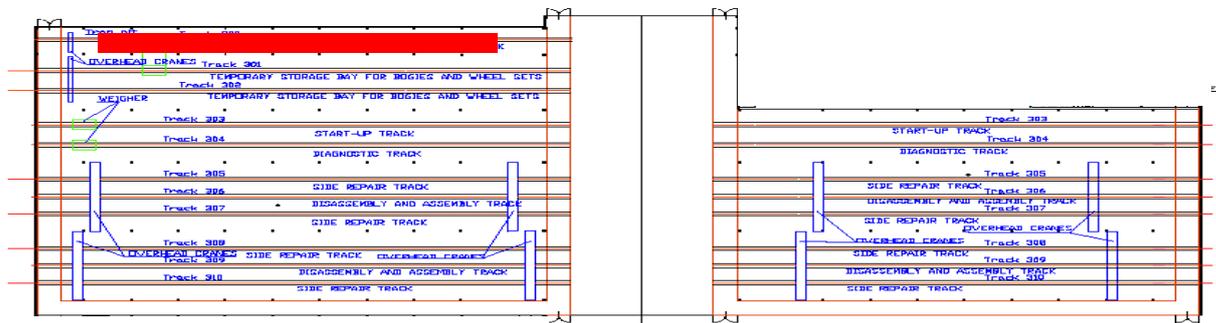


Fig. 16. Highlight of disassembly-assembly stations for emergency purposes
(Source: independent study by VIS Systems)

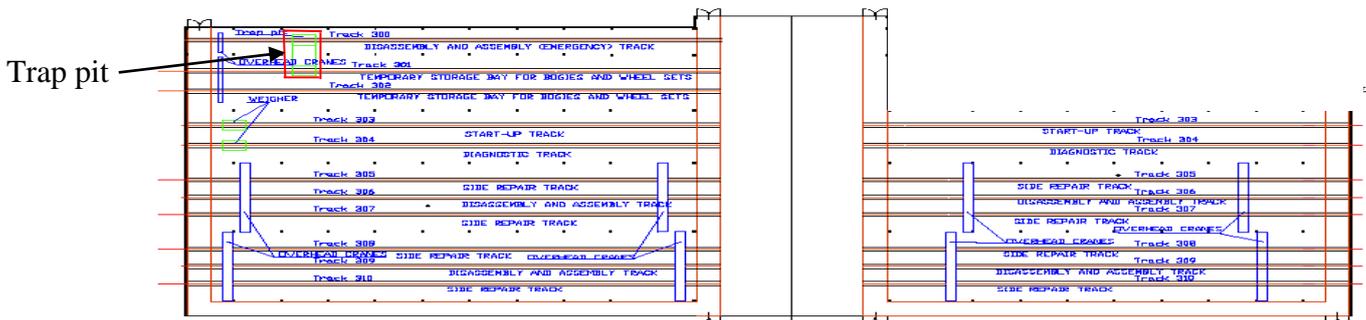


Fig. 17. Highlight of trap pit station
(Source: independent study by VIS Systems)

The main reason why the trap pit is situated at the disassembly-assembly station for emergency repairs is the possibility of replacing damaged wheel sets or drive units without having to transport boxes to the assembly - disassembly station. It can also be used to replace sets in a vehicle after a repair.

Temporary storage bays for bogies and wheel sets are located next to the disassembly - assembly station designated for emergency repairs. The station will be

equipped with 15 tons load capacity overhead cranes. A part of the trap pit will also be situated at this station and connected with the emergency repair station by means of a tunnel. Temporary storage bays for bogies and wheel sets (Fig. 18)

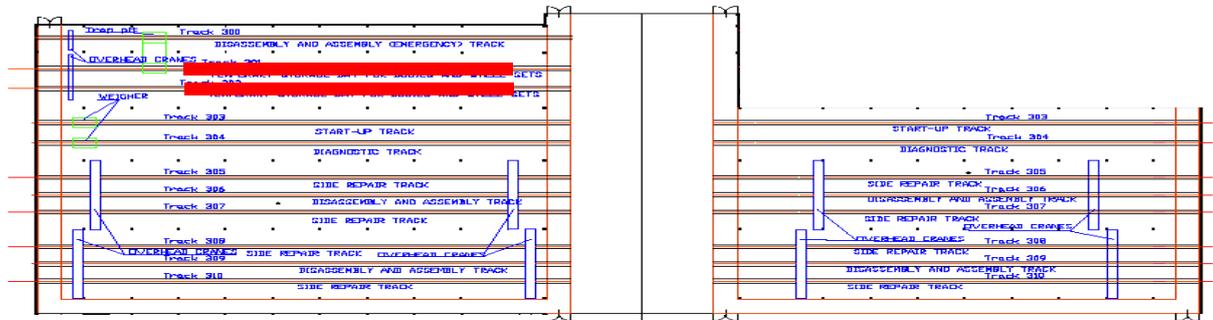


Fig. 18. Highlight of a temporary storage bay for bogies and wheel sets
(Source: independent study by VIS Systems)

2.3.3.2 Painting shop, shot-blasting shop

After a box repair has been completed, particular boxes are transported by means of an overhead crane to the painting and surface pretreatment station (Fig. 19).

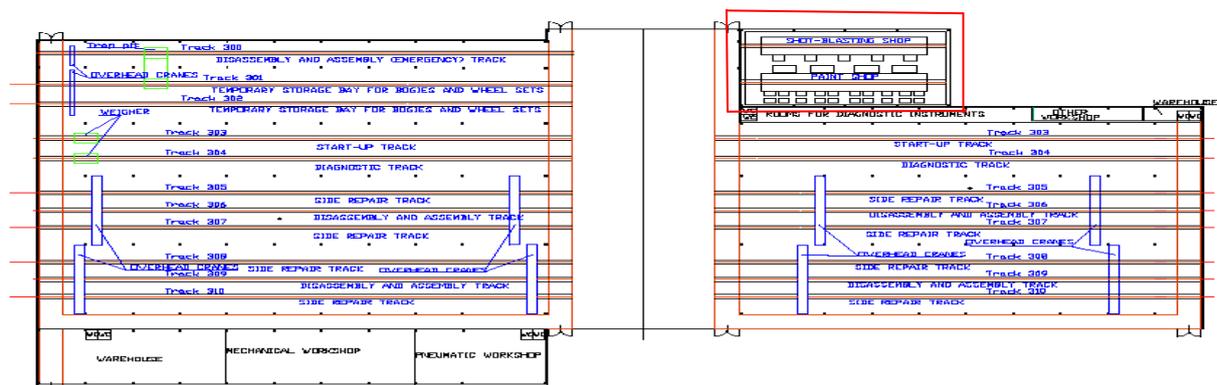


Fig. 19. Highlight of painting shop, shot-blasting shop
(Source: independent study by VIS Systems)

Surface pre-painting treatment is one of the most important operations in the entire painting process. A correctly designed surface pre-paint treatment process performed with the use of proper devices and materials has a major effect on the paint adhesion to the element or the desired external appearance of the paint coating.

Each kind of material which the painted element or subassembly is made of requires a surface pre-treatment process to be individually designed.

The following operations will be carried out at the pre-paint treatment station:

- Cleaning the body surface by removing old and damaged paint coatings (removing paint and cracked joint compound),
- Matting the original paint coating if the entire surface is coated with new one,
- Filling cavities in joint compound to be painted (applying new levelling joint compounds),
- Drying joint compounds,
- Levelling surfaces of joint compounds by grinding,
- Degreasing and dedusting surfaces before painting.

Fig. 20 shows examples of the pre-paint surface treatment station and of the paint chamber.

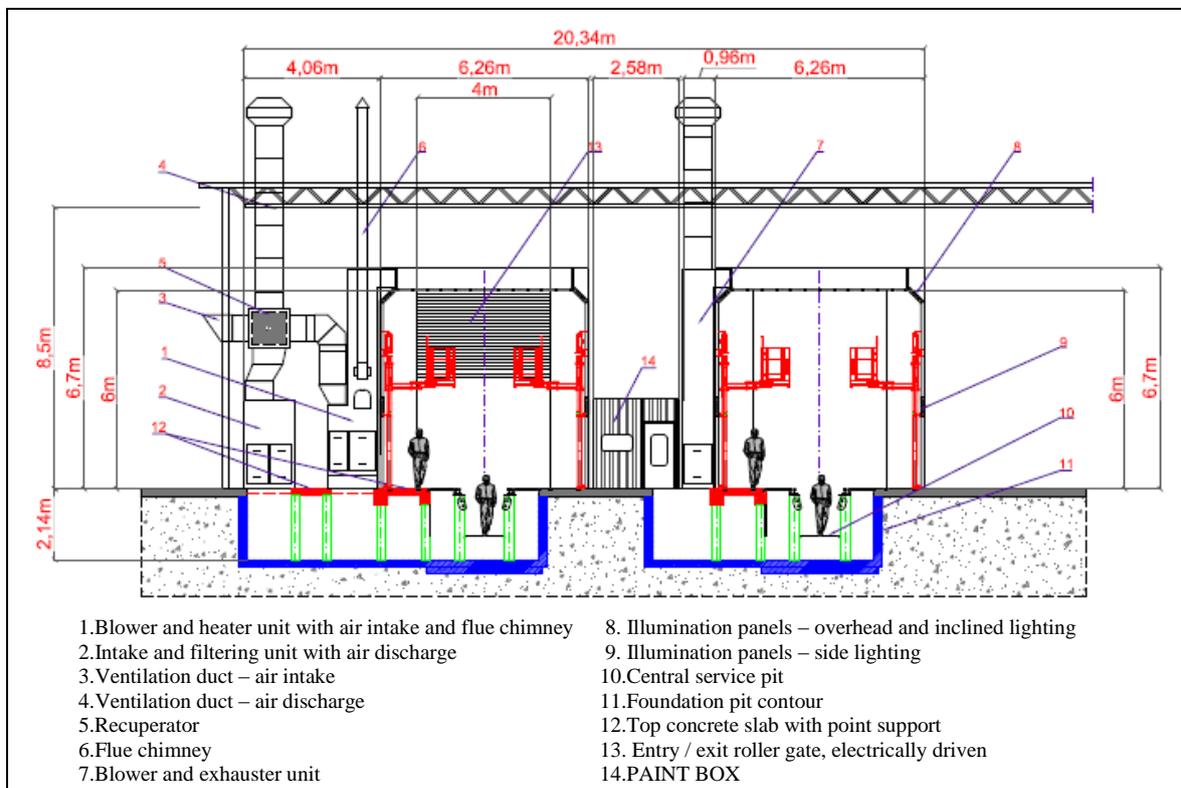


Fig. 20. Dimensional scheme of the pre-paint treatment station and the paint chamber station
(Source: Nova VERTA)



Example of pre-painting treatment facility station. (Photo: Nova VERTA)



Visualisation of the control system on the screens controlling the pre-paint treatment station and the paint facility (Photo: Nova VERTA)



Pre-treatment station seen from the inside (Photo: Nova VERTA)



Example of a paint chamber station with a blow and ventilation system (Photo: Nova VERTA)

2.3.3.3 Repair Workshops.

The vehicle box repair room adjoins to the repair shops used to remanufacture or manufacture less complicated mechanical parts and to remanufacture and check devices (Fig. 21).

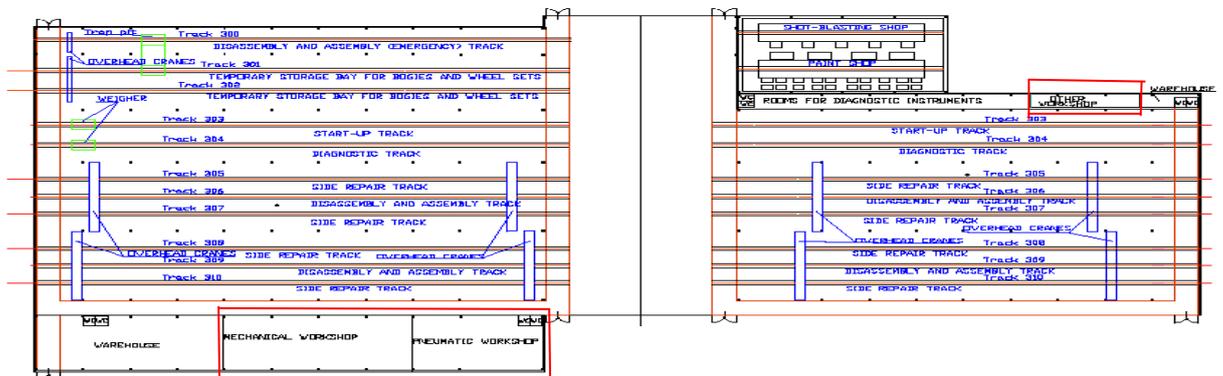


Fig. 21. Highlight of repair shops
(Source: independent study by VIS Systems)

2.3.3.3.1 Mechanical and metal working workshop

The repair shops are used to repair and check subassemblies and devices both in the old type EZT vehicles and their derivatives which are repaired in the short repair room as well as sets and vehicles of various types repaired in the long room. Considering the necessity to interconnect the track system of the inspection room and the repair room, the workshops have been removed from the area where the tracks are planned to be built. The study presents a proposed concept of equipment for the repair workshops. The list of necessary equipment will depend on the actual range of works carried out independently by the Rolling Stock Repair and Operation Section in Sochaczew and its needs. The range of the operations and the diagnostic and repair equipment to be procured should be determined so as to fit the area of the workshops. Possibly, it is recommended to consider placing machines and repair equipment in the existing workshops situated in the inspection and repair room (Fig. 22).

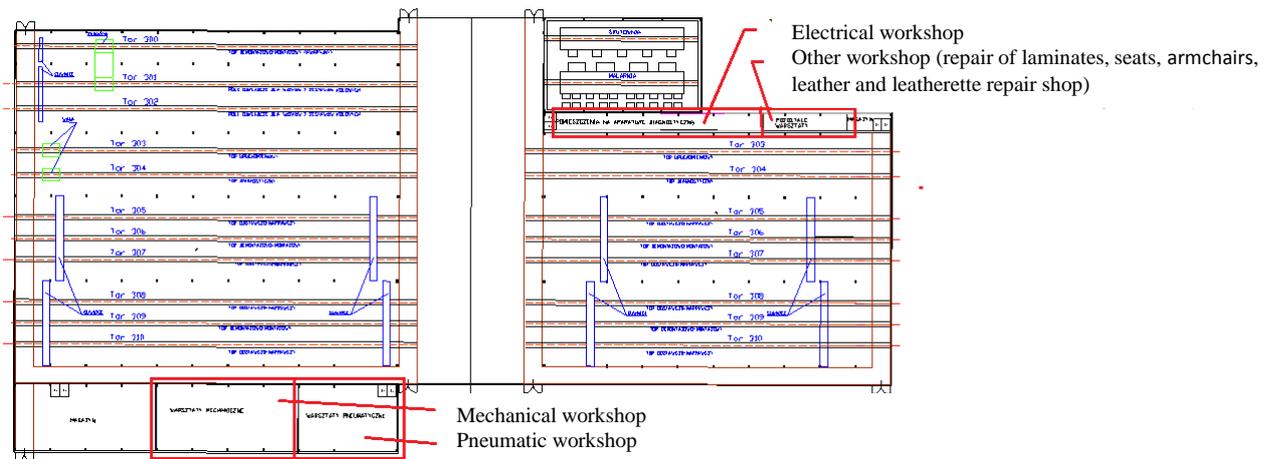
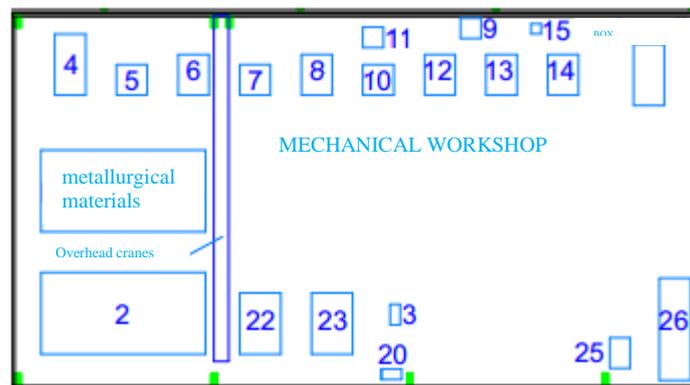


Fig. 22. Highlight of repair shops
(Source: independent study by VIS Systems)

2.3.3.3.2 Mechanical and metal working workshop

The mechanical and metal working workshop will manufacture new elements such as bushings, studs, shafts and damaged components of the box structure and remanufacture mechanical subassemblies.



Item	Equipment/machine
1	Overhead crane, 5t
2	Laser burner
3	MIG-MAG-TIG welder
4	Tool milling machine
5	Vertical milling machine
6	Universal lathe
7	Pillar drill
8	Radial drill
9	Table drill
10	Band saw
11	Disc cutter
12	Grinder for pipes

13	Grinder for planes
14	Grinder for holes
15	Tool grinder
16	Sharpener
17	Envelope grinder
18	Hydraulic press
19	Hand-operated plasma cutter
20	Gas welding set
21	Pneumatic angle grinder
22	Hydraulic guillotine
23	Hydraulic bending machine
24	Set of measuring instruments
25	Multi-purpose press for tests of railway buffers
26	Station for dynamic testing of draw gears

Fig. 23. Layout of equipment and machines in the mechanical workshop.

Source: independent study by VIS Systems.



Exemplary laser burner



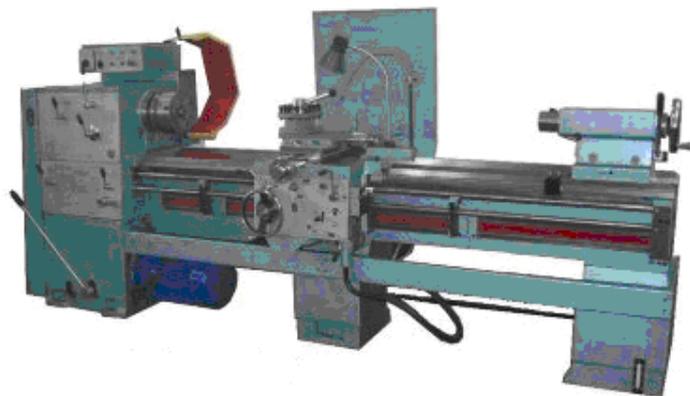
Exemplary equipment for welding by TIG and MIG/MAG method



Exemplary tool milling machine



Exemplary vertical milling machine



Exemplary universal lathe



Exemplary carousel milling machine



Exemplary boring machine



Exemplary pillar drill



Exemplary radial drill



Exemplary table drill



Exemplary band saw



Exemplary grinder for shafts



Exemplary disc cutter



Exemplary grinder for holes



Exemplary grinder for planes



Exemplary hydraulic press



Exemplary plasma cutter



Exemplary hydraulic guillotine



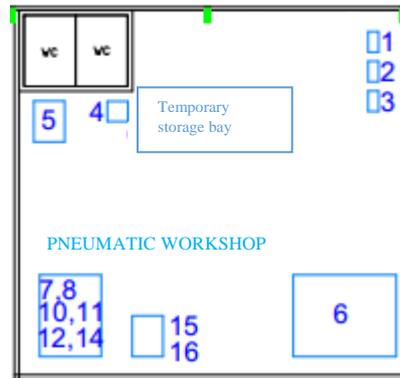
Exemplary hydraulic bending machine



*Exemplary bending machine for pipes
(The examples are sourced from manufacturers' and vendors' advertising materials)*

2.3.3.3.3 Pneumatic workshop.

The purpose of the electrical workshop will be to check and repair units of the pneumatic and brake system. The workshop will include stations, each with a set of operations and a scope of works assigned to it.



Item	Equipment/station
1	Bending machine for pipes
2	Disc cutter
3	Threader for pipes
4	Table drill
5	Band grinding machine
6	Station for pressure tests of tanks
7	Station for checking and testing brake valves.
8	Station for checking return valves, reduction valves, shut-off valves etc. with tooling.
8a	Station for the repairs of the engine driver's valves with tooling.
10	Station for checking the engine driver's valves.
11	Station for checking sirens.
12	Station for checking safety valves.
	Compressor with air tanks
14	Station for checking and adjustment of pressure disconnectors.
15	Station for the repair of the door opening system.
16	Station for the repair of the retractable step system.

Fig. 24. Layout of equipment and machines in the pneumatic workshop.
(Source: independent study by VIS Systems)

Station for pressure tests of tanks.

The station will make it possible to carry out pressure tests of air reservoirs and to check if the reservoirs are tight.

Station equipment:

- Water tank,
- Electrical water pump for filling up and emptying the tanks,
- Pressure gauge,
- Hand-operated pump designed to increase pressure in the tank being inspected up to a required level.

Station for the repair of brake valves with tooling.

The following operations will be carried out at the station:

- Brake valves are disassembled,
- Particular valve elements are verified,
- Depending on how the individual subassemblies have been qualified, they are repaired or replaced with new subassemblies,
- Assembly of valves.

Brake valve test station.

This is the station where brake valves are tested after the brake valves have been repaired. The station will be equipped with tooling for testing valves of all types of vehicles which are planned to be maintained at this facility. The station will be equipped with a computer system for the control of measured parameters and will automatically generate a valve test report with detailed information about the exceeded parameters if such occur.



Fig. 25. Exemplary brake valve test station.

Photo: VIS Systems.

Station for checking and repairing return valves, reduction valves, shut-off valves etc. with tooling. This is the station where operation related to checking, adjusting (reduction valves) and repairing valves are carried out.

Valves which cannot be repaired or adjusted due to their specific design will be qualified for further operation or replacement.

Station for the repairs of the engine driver's valves and accessories.

The following operations will be carried out at the station:

- Brake valves are disassembled,
- Then the particular valve elements are verified,
- Depending on how the individual subassemblies have been qualified, they are repaired or replaced with new subassemblies,
- Assembly of valves.

Station for the inspection of the engine driver's valves.

The station will be used to inspect the engine driver's valves. The station will be equipped with indispensable tools which allow checking the valve parameters.

Station for the inspection of sirens.

The station will be used to inspect pneumatic sirens. The station equipment will include measuring devices which enable measurement of sound intensity and frequency.

Station for checking safety valves.

The station will be used to check and adjust safety valves. Its equipment will include an air reservoir and a compressor which will enable reaching the opening pressures of the safety valves.

Compressor with air tanks.

The pneumatic workshop will be equipped with an independent compressor with an air preparation unit and air reservoirs provided only to support the workshop stations.

Station for checking and adjusting pressure disconnectors.

This station will be used to check pre-sets of pressure disconnectors. The auxiliary station will be used to repair and adjust the disconnectors.

Station for the repair of the door opening system and retractable steps.

The station will be equipped with tooling necessary to check whether the door opening systems and retractable steps work correctly. In addition, pneumatic subassemblies of the above systems will be repaired at the station.

2.3.3.3.4 Electrical workshop

The purpose of the electrical workshop is to check devices and prepare electrical harnesses for the repaired vehicles. The workshop will include stations, each with a set of operations and a scope of works assigned to it.

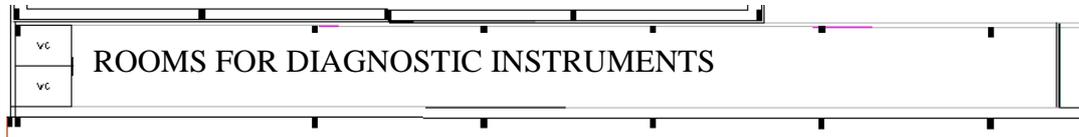


Fig. 26. Electrical workshop with rooms for diagnostic instruments.
(Source: independent study by VIS Systems)

The electric workshop equipment includes:

- Station for checking WN [high voltage] and NN [low voltage] cabinets
- Station for checking the vigilance device and the SHP [Automatic Train Braking] generator.
- Station for checking speedometer,
- Station for preparing wire harnesses,
- Measuring instruments.

2.3.3.3.5 Other workshops

To carry out small repairs of vehicle subassemblies, it is necessary to build a repair workshop for doors, windows and vehicle interior linings, an upholstery workshop and a chair repair workshop. These workshops will carry out repairs (of seats, armchairs and doors) prepare interior and exterior linings for installation in vehicles (laminates).

2.3.3.4 Traverser

The traverser room serves as an element interconnecting the aisles of the box repair room and the paint shop. The traverser is used to transport vehicle boxes and bogies among the particular stations. After disassembly of the vehicle, bogies will be transported to the traverser and then to a temporary storage bay from where they will be forwarded to a repair service provider. The traverser width allows transporting boxes which are up to 30 metres long.

Vehicle boxes are transported between the paint shop station and the pre-paint treatment station also by means of an overhead crane.

They are pulled onto the traverser by means of the carriages and pullers.

See below for examples of how the traverser is used.



Example 1 of how the traverser is used



Example 2 of how the traverser is used

2.2.3.5 Office and Social Rooms

The office and social rooms are planned to be built on plot 5 and 6 (Fig. 27).

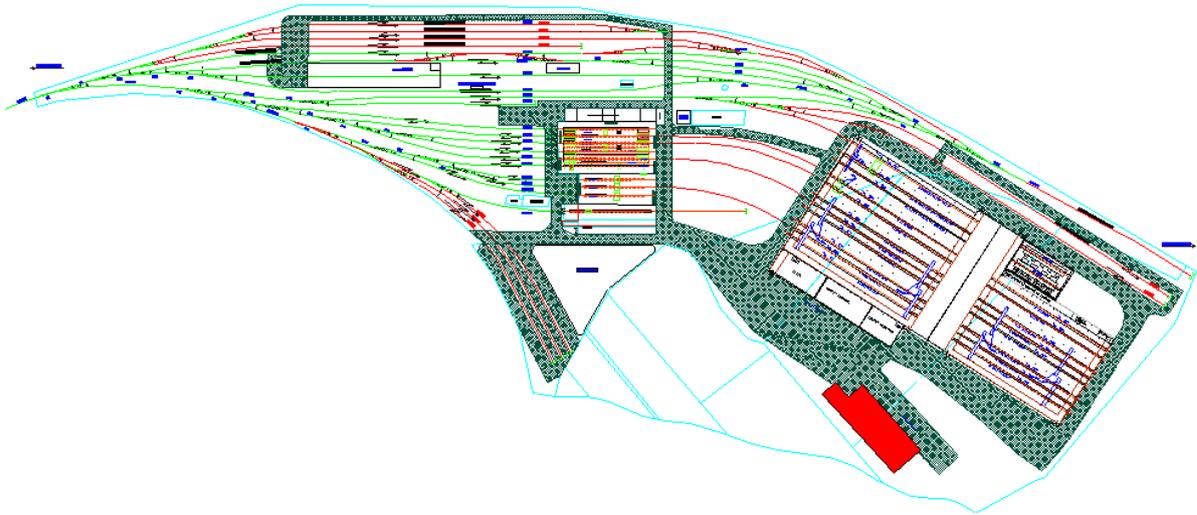


Fig. 27. Highlight of the social building.
(Source: independent study by VIS Systems)

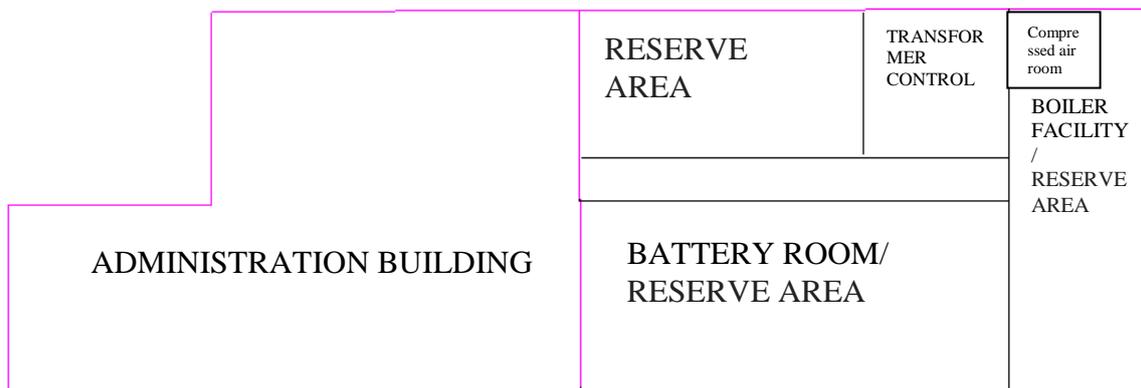


Fig. 28. Description of the division of the social building rooms
(Source: independent study by VIS Systems)

The battery facility is located next to the office and social rooms (Fig. 28).

Considering the expansion of the maintenance unit, the existing boiler room will be insufficient. Considering the above, the social building will accommodate a natural gas boiler facility which can operate as an auxiliary one or it can take over the role of the existing boiler facility and supply heat energy to the entire maintenance unit. In order to leave the existing boiler facility, it will be necessary to move the oil tanks to a location as shown on Figure 5.

2.3.4 Repair of bogies (bogie shop).

This design does not comprise building a bogie repair room. After bogies are detached from a vehicle body on the disassembly/assembly track, they will be sent outside for P4 maintenance level operations to be carried out as determined in DSU [Maintenance System

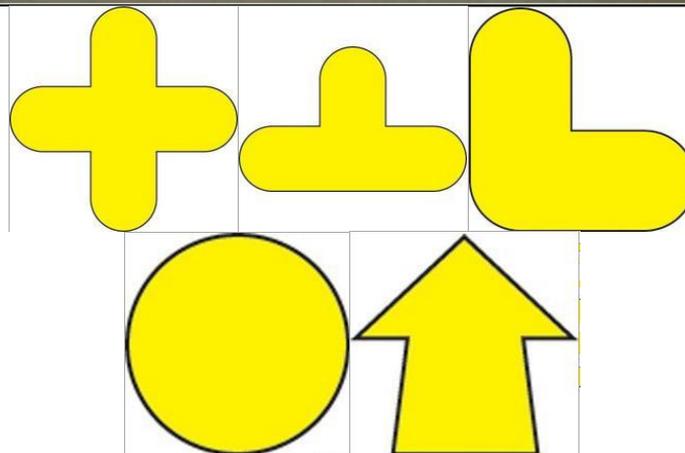
Documentation]. Therefore, it is important that the bogie repair lead time is shorter than the vehicle box repair lead time. This means that the repaired bogies should be delivered by a subcontractor at least one day before the planned date of assembling boxes and bogies. Such actions require a very well organized logistics and require entering long-term contracts with bogie repair service providers, with a special focus on the punctuality of deliveries.

3. MINIMUM REQUIREMENTS CONCERNING NECESSARY EQUIPMENT

3.1 Optimisation of markings and separation of temporary storage bays from transport routes and inspection and repair stations.

It is recommended to optimise the size and the method of marking of the temporary storage bays.

Floor marking system:

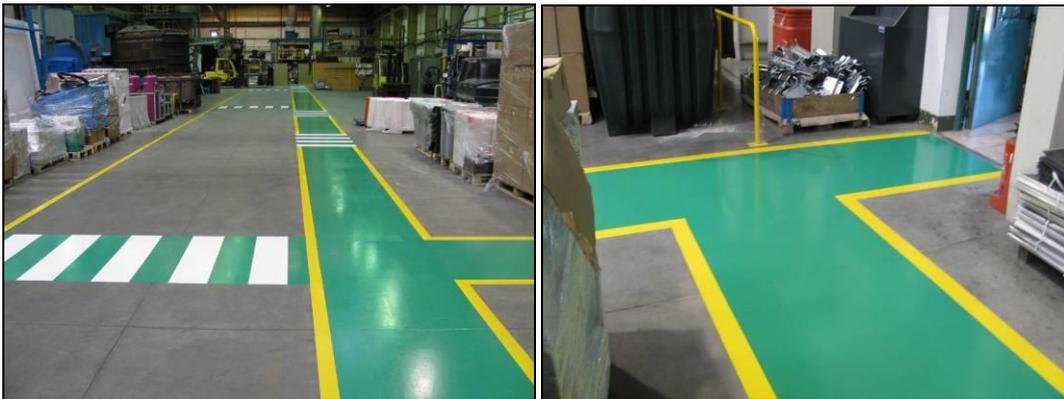


Advantages of the system:

- simple and convenient solution for marking floors in warehouses,
- designed to mark passages, areas for pallets, routes for pallet trucks etc.,

- Wide range of applications (L, T, and + for marking places for pallets, O and arrow showing the pedestrian or transport traffic direction),
- Made of high-quality PVC, equipped with strong glue,
- Resistant to full every-day operation, must be laid on an even and clean surface,
- Supplied in a pack of 100 or 10 pcs,
- Finish: self-adhesive,
- Colour: yellow.

Proper description of fields and size of places improves and speeds up the learning process. The employees will learn the entire topographical layout of the temporary storage bays. Additionally, it is recommended to optimise the existing temporary storage bays so as to ensure that they do not collide with the access ways to the inspection and repair stations. The temporary storage bays should be separated, i.e. places should be designated for subassemblies and parts to be remanufactured, scrapped or those which have been remanufactured and are ready for installation, in such places or in such a way as to prevent a mistake. If there is a shortage of area and subassemblies cannot be divided or separated, it is recommended to implement a colour code system on identifiers where, for example, the red colour would represent a broken subassembly and the green colour - a subassembly good to installation.

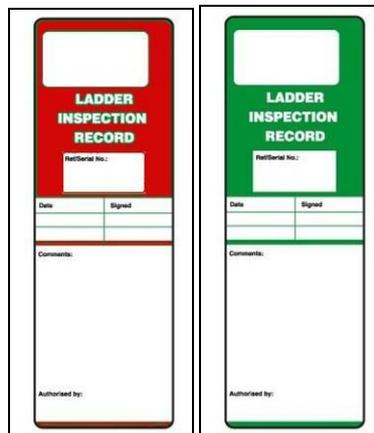


View of markings of transport routes and paths.



View of marking of pedestrian traffic routes.

Source: <http://www.czystosc.net.pl/oznakowanie-pozioame.html>



System of colour information labels

Source: http://www.topserw.com.pl/c,82,system_blokad_i_zawieszek

3.2 Workshops.

We recommend to modify workshop stations (mechanical workshop, pneumatic workshop, paint shop and metal-working station) by implementing the plan of location and storage of spare subassemblies and parts which are used to carry out operations within the P1 to P4 maintenance levels, (which failed and are repaired on site or have already been repaired and wait to be installed in the vehicle).

The plan would also consist in equipping the workshops with a system of racks and hangers and identifiers which would enable proper segregation and easy storage of subassemblies. It would also be necessary to implement a system of tags containing information about the status of the subassembly, similarly to the temporary storage bays.

3.3 Equipping of inspection stations with stationary system for water tanking and sewage removal from vehicles (optional) or mobile 2-purpose carriages.

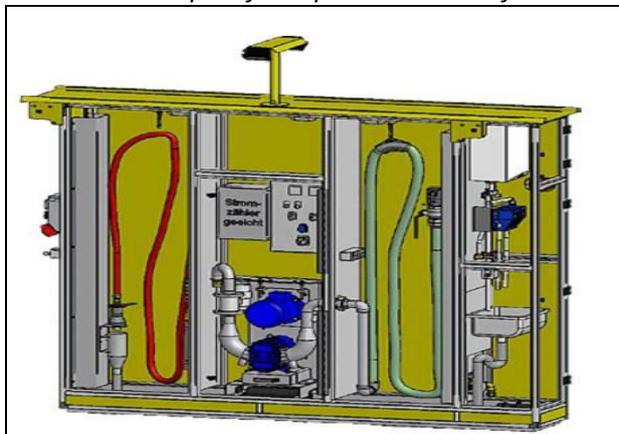
The water tanking stations are used to replenish water in the vehicles where a closed loop toilet system is installed.

The proposed solution is connected to the sewage removal system and constitutes a compact solution with a drain connection for toilets, a fresh water supply connection and a vacuum station with a control panel.

In case when it is necessary to remove sewage outside in emergency conditions, it is possible to use mobile carriages for sewage removal or a mobile sewage removal pump.



Example of compact structure of the water tanking and sewage removal station.



Another example of compact structure of the water tanking and sewage removal station with the external installation option. Source: <http://www.vogelsang.info/?id=30>



Exemplary use of a mobile pump for faecal sewage removal from a car. In this case, it is necessary to provide a relatively close access to the sewage drain designed to take over faecal sewage.



Example of mobile carriages used for water tanking and sewage removal.

Source: <http://www.vogelsang.info>

3.4 Equipment of P3 maintenance level inspection stations with complete set of Kutruff type screw lifters.



Example of screw lifters.



*Another example of mobile screw lifters.
Source: <http://www.ikotec-polska.pl/>*

3.5 Stationary drive-through washing facility and ice protection station

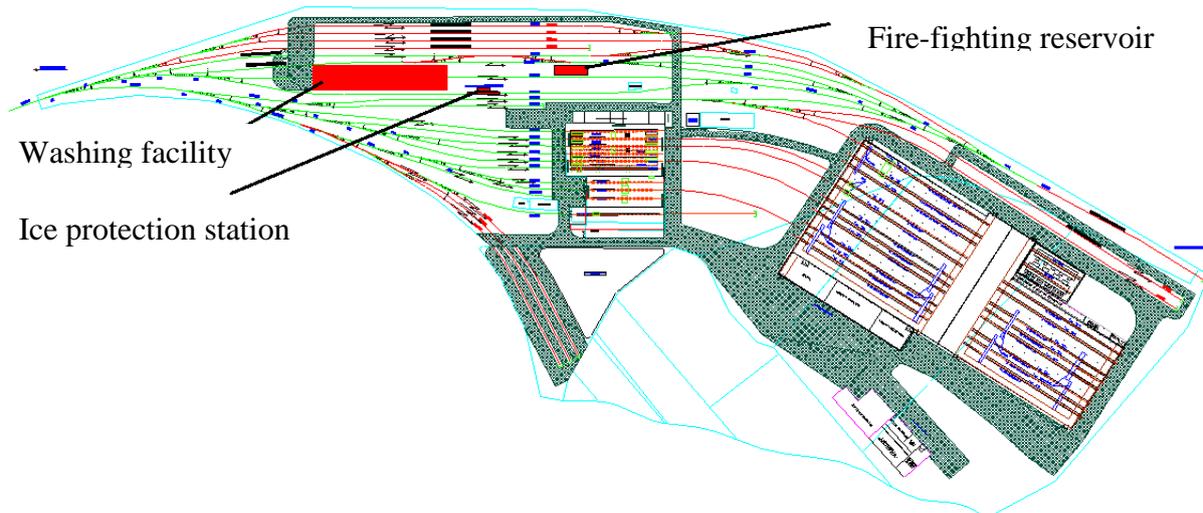


Fig. 29. Highlight of the washing facility and the ice protection station
(Source: independent study by VIS Systems)

The proposed washing facility will be situated in a 100 m long room. The washing facility building will be divided into two parts. The first part of the building is designed for washing vehicles. It accommodates washing brushes, linear water drainage systems connected to the washing facility duct, heaters, utility connections and a drive-through track. The other part of the building is the second floor level. This part accommodates social rooms, technical rooms, boiler facilities, garages for mobile equipment and the septic tanker (Fig. 29 and 30).

The ice protection station will be located behind the washing facility room. The station is situated on an independent drive-through track.



Exemplary ice protection station
Source: www.corail.pl

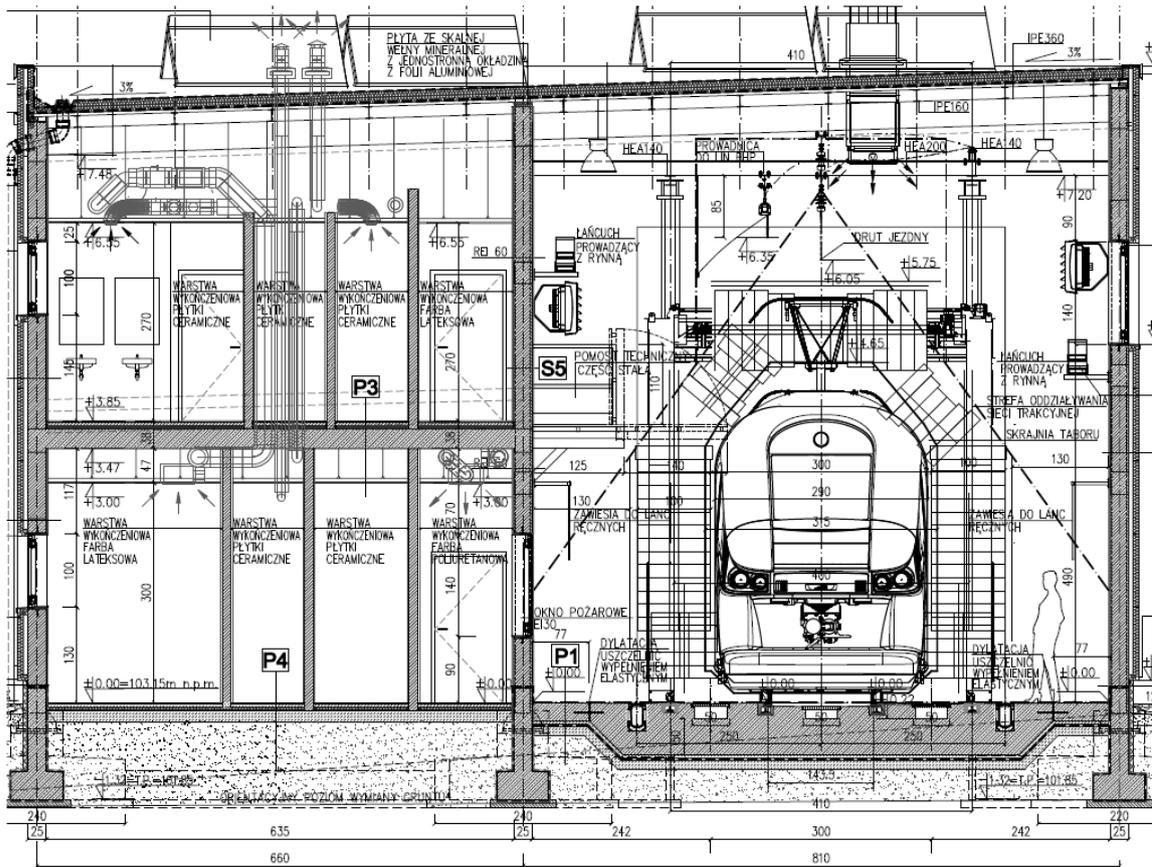


Fig. 30. Full train washing facility for the Tłuszcz project, applicable in Sochaczew.
Source: Koleje Mazowieckie – KM” sp. z o. o.

3.6 System of warehouses and urgent supplies.

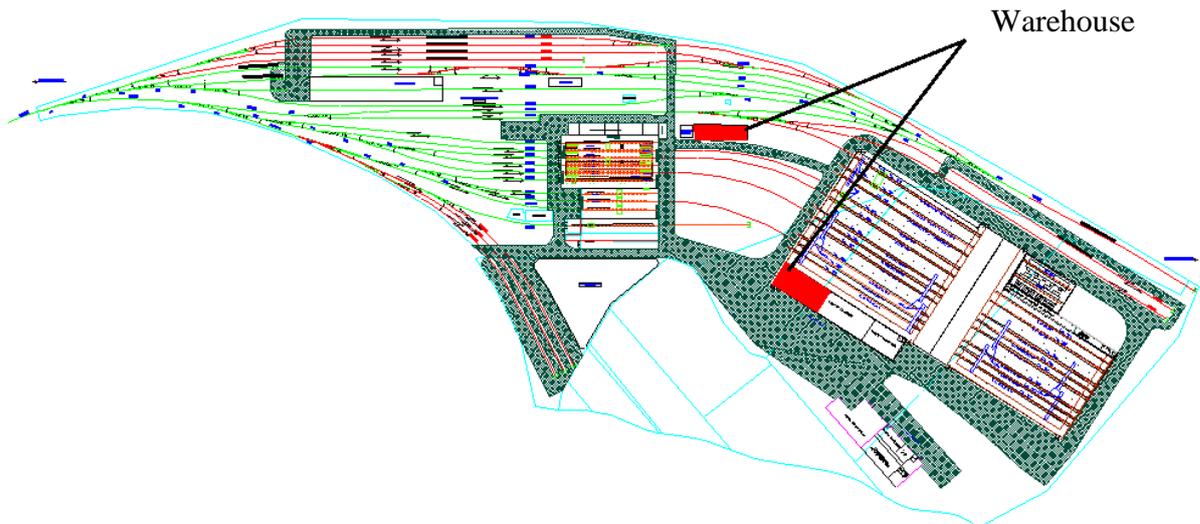


Fig. 31. Highlight of warehouses
(Source: independent study by VIS Systems)

Since it is required to ensure punctual deliveries of repair services at the P4 maintenance level and inspections at the P1-P3 maintenance level, it is necessary to develop a well operating system of on-hand warehouses and a fast urgent procurement procedure. The most significant obstacle here is the requirement to follow the Public Procurement Law procedures. The Section Manager must be authorised to initiate an operating procedure to repair a vehicle due to a damage or failure which must be removed for the vehicle to be approved for further operation. Therefore, it is of essential importance to develop an effective system of on-hand warehouses with a minimum stock of spare parts and consumables as fixed by the management of the Section. The elements which are particularly important are the fast wearing ones and those which are of critical importance for the safety of operation. These include:

- Brake pads,
- Lubricants,
- Spare parts for pneumatic subassemblies,
- Basic spare elements for electric devices
- Glass panes (with special focus on windscreens)
- Headlamps and parts of the external lighting of vehicles
- Spare parts for external doors,
- Defrosting and antifreeze chemicals,
- Circulation reserve of the SHP [Automatic Train Braking] systems and a vigilance control system,
- Parts for recorders (in sections with qualified personnel).

4. CALCULATIONS AND SUMMARY

4.1 Initial Cost Estimate.

4.1.1 Part related to the construction and infrastructure.

Comprehensive summary of works - initial estimate Part related to the construction and infrastructure					
Item	Type of works	Units	Quantity	Unit value	Value (PLN)
A	Site development				
1	Roads	m2	26,294		
2	Tracks - drainages and dewatering	km	1.650		
3	Construction of new tracks (49E1 tracks in room)	km	2.172		
4	Construction of new tracks (49E1 wooden sleepers)	km	4.473		
5	Construction of new single railroad switches (Rz 1:9 R=190)	pcs	19		
6	Construction of reinforced concrete buffer stops	pcs	9		
7	Construction of railway crossings	m2	624		
8	Filling tracks with crossing slabs (holding sites, storages etc.)	m2	1,300		
9	Rain water drain system	m.	9,750		
10	Water supply network	m.	750		
11	Heating network	m.	225		
12	Gas network	m.	150		
13	Sewage system	m.	750		
14	Fire-fighting network	m.	4,875		
15	Electrical part, CCTV	sets	1		
16	Railway switch heating systems (EOR) (total power: approx. 720 kW)	sets	47		
17	Traction network	km	3.961		
18	Power supply and traction substations (demand: approx. 7.5 MW)	sets	1		

Comprehensive summary of works - initial estimate Part related to the construction and infrastructure					
Item	Type of works	Units	Quantity	Unit value	Value (PLN)
19	Site grading works	m2	285,000		
A	Total:				
B	Objects				
1	Overhaul room with the traverser room, paint shop, workshops, battery room and warehouse	m2	26,049		
2	Social and office building	m2	600		
3	Compressor building	pcs	1		
4	Gas boiler room	pcs	1		
5	Transformer substation	pcs	1		
6	Warehouse of hazardous materials	m2	90		
7	Room for industrial waste	m2	90		
B	Total:				
C	Other works				
1	Assumed to be 5% of the works contained in the development and the buildings				
C	Total:				
D	Legal works				
1	Value of the construction design documentation (excluding the technology) - assumed to equal 3% of the development project value				
D	Total:				
TOTAL A+B+C+D:					

Table: Initial cost estimate - part related to construction and infrastructure.

4.1.2 Engineering Part - Equipment

4.1.2.1 Comprehensive Summary

Comprehensive summary of technical equipment				
Item		Location of equipment	Sochaczew	
E	All buildings and workshops in total			Value
1	Repair room			
2	Paint shop			
3	Mechanical workshop			
4	Pneumatic workshop.			
5	Electrical workshop			
6	Other workshops			
7	Battery room			
8	Train washing station			
9	Ice protection station			
10	Warehouse equipment			
11	Budgetary reserve			
E	Total:			

4.1.2.2 Detailed Summary of Interior Equipment.

a) Repair Room

Item	Equipment	Unit price	Quantity	Unit	Total price
1	Vehicle start-up stand		1	sets	
2	Wheel pressure measurement station		1	pcs	
3	Station for testing vehicle brake system		1	pcs	
4	Transverser		1	pcs	
5	Overhead crane, 30 tons		8	pcs	
6	Overhead crane, 15 tons		1	pcs	
7	Overhead crane, 5 tons		1	pcs	
8	Kutruff screw lifter (minimum version)		40	pcs	
9	Hand-operated pressure washer		2	pcs	
10	Industrial mobile vacuum cleaner		2	pcs	
11	Mobile platform with adjustable height		16	pcs	
12	Pneumatic wrench		2	pcs	
13	Pneumatic wrench		3	pcs	
14	Pneumatic oscillating sander		1	sets	

Item	Equipment	Unit price	Quantity	Unit	Total price
15	Pneumatic angle grinder		2	pcs	
16a	Set of measuring instruments for checking box geometry		1	sets	
16b	Engineering bogie		16	pcs	
17	Low technical supports (racks)		20	pcs	
18	High technical supports (racks)		10	pcs	
19	Set of on-hand tools		15	pcs	
20	MIG-MAG-TIG welder		1	pcs	
21	Gas welding set		2	pcs	
22	Set of measuring instruments for checking the vehicle electric system		1	pcs	
23	Device for emptying and filling up the air conditioning system		1	pcs	
24	Scissor lift		4	pcs	
25	Device for testing Hasler speedometers		1	pcs	
26	Car body measurement station with a set of measuring instruments		1	pcs	
27	Instrument for measuring the buffer disk wear degree		1	pcs	
28	Vernier scale instrument for measuring the distance of the buffer axis from the rail profile head		1	pcs	
29	Other items not included in the summary		1	sets	

b) Paint Shop.

Item	Equipment	Unit price	Quantity	Unit	Total price
1	Pre-painting treatment chamber		1	pcs	
2	Paint chamber		1	pcs	
3	Tooling (grinders, paint spray guns and others) with a paint preparation chamber		1	sets	

d) Mechanical Workshop

Item	Equipment	Unit price	Quantity	Unit	Total price
1	Overhead crane, 5t		1	pcs	
2	Laser burner		1	pcs	
3	MIG-MAG-TIG welder		1	pcs	
4	Tool milling machine		1	pcs	
5	Vertical milling machine		1	pcs	
7	Universal lathe		1	pcs	
8	Pillar drill		1	pcs	
9	Radial drill		1	pcs	
10	Table drill		1	pcs	
11	Band saw		1	pcs	
12	Disc cutter		1	pcs	
13	Grinder for pipes		1	pcs	
14	Grinder for planes		1	pcs	
15	Grinder for holes		1	pcs	
16	Tool grinder		1	pcs	
17	Sharpener		1	pcs	

Item	Equipment	Unit price	Quantity	Unit	Total price
18	Envelope grinder		1	pcs	
20	Hydraulic press		1	pcs	
21	Hand-operated plasma cutter		1	pcs	
22	Gas welding set		1	pcs	
23	Pneumatic angle grinder		2	pcs	
24	Hydraulic guillotine		1	pcs	
25	Hydraulic bending machine		1	pcs	
26	Set of measuring instruments		1	pcs	
27	Multi-purpose press for tests of railway buffers		1	pcs	
28	Station for dynamic testing of draw gears		1	pcs	
29	Other items not included in the summary		1	pcs	

e) Pneumatic workshop

Item	Equipment	Unit price	Quantity	Unit	Total price
1	Bending machine for pipes		1	pcs	
2	Disc cutter		1	pcs	
3	Threader for pipes		1	pcs	
4	Gas welding set		1	pcs	
5	Table drill		1	pcs	
6	Band grinding machine		1	pcs	
7	Station for pressure tests of tanks		1	pcs	
8	Brake valve test station		1	pcs	
9	Station for checking and repairing return valves, reduction valves, shut-off valves etc. with tooling.		1	pcs	
10	Station for the repairs of the engine driver's valves with tooling.		1	pcs	
11	Station for checking the engine driver's valves.		1	pcs	
12	Station for checking sirens.		1	pcs	

Item	Equipment	Unit price	Quantity	Unit	Total price
13	Station for checking safety valves.		1	pcs	
14	Compressor with air tanks		1	pcs	
15	Station for checking and adjustment of pressure disconnectors.		1	pcs	
16	Station for checking compressors		1	pcs	
17	Station for the repair of the door opening system.		1	pcs	
18	Station for the repair of the retractable step system.		1	pcs	
19	Other items not included in the summary		1	pcs	

f) Electrical workshop

Item	Equipment	Unit price	Quantity	Unit	Total price
1	Station for checking WN [high voltage] cabinets		1	sets	
2	Station for checking NN [low voltage] cabinets		1	sets	
5	Station for checking and repairing the vigilance device and the SHP [Automatic Train Braking] generator.		1	sets	
6	Station for checking and repairing the radiotelephone.		1	sets	
7	Station for checking and repairing speedometers		1	sets	
9	Station for preparing wire harnesses		1	sets	
11	Other measuring instruments		1	sets	
12	Other items not included in the summary		1	sets	

a) Other workshops

Item	Equipment	Unit price	Quantity	Unit	Total price
1	Repair workshop for doors and windows		1	sets	
2	Repair workshop for vehicle interior linings and external laminates		1	sets	
3	Upholstery workshops, repair of seats		1	sets	
4	Reserve		1	sets	

5. COST SUMMARY SUMMARY

The presented summary of the initial costs of construction of individual buildings with required (optimised) technical equipment of rooms and repair workshops is situated on the area of acquired adjacent plots 1, 2, 3, 4, 5 and 6 and plot 7 (acquisition underway), with the Rolling Stock Repair and Operation Section in Sochaczew. This site has been overlaid with required buildings of rooms, repair workshops and social rooms, with the range of works, technology employed to carry out inspections and repairs and transport logistics taken into account.

The presented calculation includes required building, infrastructural and engineering costs. The option in which the calculations being discussed have been completed does not include installation of railway traffic control systems.

Note: The following calculations do not account for the costs of acquisition and purchase of land plots 1, 2, 3, 4, 5, 6 and 7. These costs should be added to the total costs of the following summaries.

Item	Costs	Without being equipped with the rail traffic control
1	Section related to the construction and infrastructure SITE DEVELOPMENT	
2	Section related to the construction and infrastructure OBJECTS	
3	Section related to the construction and infrastructure REMAINING WORKS (5%)	
4	Section related to the construction and infrastructure DESIGN DOCUMENTATION (3%)	
5	Technical equipment	

In order to let the existing inspection and repair room in Sochaczew provide P1-P3 maintenance level services to new vehicles, it is necessary to procure required engineering equipment, i.e.:

Item	Type of works and device	Units	Quantity	Unit value	Value
A	Inspection Room				
1.	Kutruff type screw lifters (including 4 spare ones or replacement of the existing ones if necessary)	pcs	16		
2.	Water filling system	sets	1		
3.	Sewage removal system	sets	1		
4.	Carriage for sand-blasting	sets	1		
5.	Industrial vacuum cleaners	sets	3		
6.	Frames with utilities (current, air)	sets	2		
8.	Station for testing vehicle brake system	pcs	1		
9.	Station for measurements and tests of electrical instruments (converters + static converter)	sets	1		
10.	Station for measuring and testing the air conditioning	sets	1		
11.	Scissor lift	pcs	2		
12.	Defectoscope	pcs	1		
13.	Set of on-hand tools	pcs	4		
14.	Pneumatic wrench	pcs	1		
15.	Set of portable measuring laser instruments	pcs	1		
16.	In-house transport trolleys	pcs	2		
A	Total:				
B	Other				
1	The technical equipment costs have been assumed to be 10%, other costs related to the auxiliary equipment and the ditch reconstruction				
B	Total:				
C	Legal works				
1	Commissioning, approvals, certificates, measurements etc.. (2%)				
C	Total:				

Table. Technical equipment for servicing new vehicles, required to carry out the P1-P3 maintenance level inspections of new rolling stock in the existing inspection and repair room.

The cost estimate is not included in the summary of the development costs of the Rolling Stock Repair and Operation Section in Sochaczew.

The very important factor related to the punctual delivery of the vehicle maintenance level services is the time of repair of the individual devices or subassemblies sent to service vendors. The punctuality of deliveries of particular devices delivered from a vendor must conform to the production (repair) schedule.

With regard to the P3 maintenance level inspections and the P4 maintenance level repairs, it is recommended that specially qualified teams are formed to handle specific repair tasks, e.g. pneumatic engineers, carpenters, electricians etc.

The provided number of Kutruff lifters represents a minimum required equipment of the repair room. Their final number will depend on the types of vehicles and their length.

The presented variant of the development and layout of the Rolling Stock Repair and Operation Section in Sochaczew will also require employing blue-collar workers carrying out the P4 maintenance level repairs. The number of the office administration employees will depend on the actual needs of the Company. The estimate demand for manpower required to deliver the P4 maintenance level services is presented below:

Increase of employment required to deliver the P4 maintenance level services				
Item	Production floor employees required to deliver the P1-P3 maintenance level services (existing maintenance levels)	Production floor employees required to deliver the P4 maintenance level services	Specialists required to deliver the P4 maintenance level services*	Total
1.				

* lathe operators, welders, process engineers specialised in automation, mechanics, electronics and electrical systems as well as employees carrying out special processes, e.g. repairing timing valves.

Table: Number of employees required to carry out planned inspections and repairs of vehicles.

It has been assumed that work will be done in the 24/7 system to ensure that the Section works continuously. The employment increase calculation takes into account sick leaves and holiday leaves (15%) and rolling stock failures (11%). The labour intensity required to carry out a repair at the P4 maintenance level is 4000 operating hours for three-module vehicles and 5200 operating hours for five-module vehicles. It has also been assumed that the actual monthly efficiency of an employee is 140 h.

6. LIST OF ATTACHMENTS:

2D Drawings:

Attachment 1 - Track system and site development

Attachment 2 - Track system and site development - visualisation 1

Attachment 3 - Track system and site development - visualisation 2