

Organization of Non-Normative Transport in Poland

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In Poland since a few years we can notice an increase in traffic. The largest part (over 85%), are trucks that typically have a width up to 2.45 m and weigh up to 24 tonnes. The road network in our country allows for easy and comfortable movement and transport of goods. The problem arises, however, when transported cargo exceeds the dimensions or loads for standard vehicle. Then we call it oversized or non-standard.

All big investments are associated with the need to transport large, heavy or awkward form factor goods. The transport of oversized cargo by land roads has become increasingly popular. Despite the high costs of preparing the transport, land roads are more often chosen for transporting very large components. Travelling on public roads provides faster and more convenient transport in relation to waterways and railways. It makes possible direct transport from A to B, without reloading the goods at railway stations and ports.

Organizing such a passage is connected with the fulfilment of certain requirements, in accordance with the regulations and laws. If the load is larger, there are more conditions that must be met to obtain a permit for the carriage. In this article there is a characterization of the different categories of permits and shows all of the conditions that must be met in order to obtain the authorization.

There is also placed an exemplary analysis of this bridge, comparing the effort of a bridge under load class A to the effort of the bridge, caused by load analyzed oversized vehicle.

In this article you will also find information how to plan freight transport of oversized load and what do you have to look for when you choose a route.

Although carrying loads of considerable size mainland becomes increasingly popular, the barrier is still a considerable amount of paperwork that must be met in order to be able to take place carriage. Also the time, we have to wait for permits and decisions of the authorities is very long. Maybe one day the law enters into force, regulating the rules of travelling and designating routes for which you will not need to do so many formalities. Today, however, we need to adapt to the prevailing regulations.

Keywords: non-normative transport; oversized cargo, non-standard vehicle.

1. INTRODUCTION

For a few years, a significant increase of traffic can be observed in Poland. The largest part (over 85%) are trucks which are typically 2.45 m wide and which weigh 24 tonnes. The road network in our country allows an easy and comfortable movement and transport of goods. The problem arises, however, when the transported cargo exceeds the dimensions or loads for standard vehicles. In that case we can generally speak of oversized or non-standard vehicles.

According to the Act of 21st March 1985 on Public Roads "*oversized vehicle - a vehicle or combination of vehicles whose axle loads with*

cargo or without it are greater than the limit specified for the particular road in the provisions of this Act, or the dimensions and weight with or without a load are greater than the limit laid down in the regulations on traffic, except buses in terms of axle loads."

An oversized transport requires, depending on the category, an appropriate permit, issued by the competent authority. In category I and II, the authorization is issued for divisible loads, the categories from III to VII are for indivisible loads. Indivisible loads consist of loads which have a high cost, or a high risk of damage and therefore can't be divided into smaller loads [2].

2. THE CATEGORIES OF OVERSIZE LICENCES

As it has been mentioned in the introduction, oversized vehicles are divided into VII categories of permits. The first one is a permit for vehicles of dimensions and the actual total weight of not more than acceptable, and the axle load exceeding the allowed size for the roads of permissible single drive axle load to 11,5 t, issued by the manager of the road. The permit of category I applies to travel on the municipal, county or provincial road.

The II authorization category is issued for a farm tractor and a trailer, moving on public roads, with the exception of expressways and highways. The permissible length, height and total laden weight should not be exceeded. According to this, the width should not exceed 3.5 m, and the axle load should not exceed the limit for the class of the road. In order to be able to drive on all public roads, the permission in class III is required. Moreover, the vehicle has to stay in line with the following conditions:

- axle load and total laden weight which does not exceed the allowable
- width not exceeding 3.2 m
- length not exceeding 15 m for a single vehicle, and 23 m for a combination of vehicles
- height not exceeding 4.3 m

Category IV permission is issued for vehicles which run on all public roads for which the conditions are:

- laden weight of not more than acceptable
- width not exceeding 3.4 m
- length not exceeding 15 m for a single vehicle, 23 m for a combination of vehicles, and 30 m for a combination of vehicles with torsion axles
- height not exceeding 4.3 m
- axle load exceeding the size envisaged for the roads of permissible single drive axle load to 11.5 t

To obtain a permit in category V-VII, besides the authorization of the competent authority, it is of the utmost importance to address the managers of bridges, where the vehicle will be moving.

Requirements for vehicle dimensions in the case of category V permit are similar to those for category IV, and the actual weight does not exceed 60 tonnes.

Moreover, vehicles travelling on national roads which need a permit of category VI, have similar requirements. Regardless the width of the carriageway in the case of class A, S, and G can be up to 4 m and the axle load should not exceed 11.5 t. Apart from that, category VI permits vehicles to move on the routes specified for category V.

Most of the requirements are for the vehicle belonging to the seventh category of permits that are issued for the vehicle which, with regard to the dimensions, weight, or axle load, cannot be classified in categories I to VI. Permits may be granted under the following conditions:

- load is indivisible (Fig. 1),
- the manager of the roads and bridges has agreed to the passage,
- volume of traffic on the route enables the safe transport of the vehicle,
- the technical condition of the buildings, located on the route and its environment allows to drive vehicles without damaging them [1].

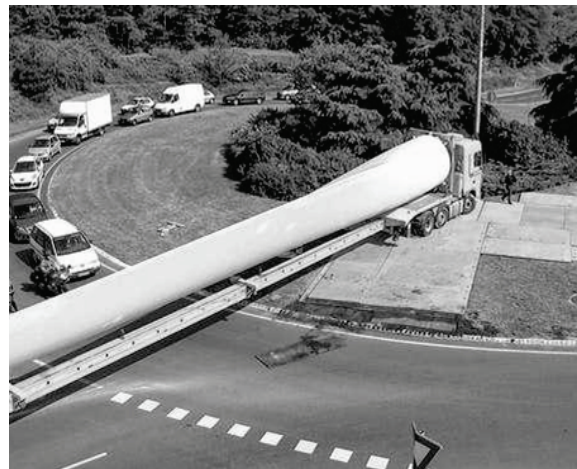


Fig. 1. Examples of indivisible loads: a windmill propeller and a silo transported on 2 trucks [8].

3. AUTHORISATION FOR NON-NORMATIVE VEHICLE

The ability to travel is being influenced by many normative legal acts, which enforce requirements like the vehicle dimensions, cargo, and the needed documentation:

- Act of 18 August 2011. Amending the Act - Road Traffic Law and some other acts (Journal of Laws No 222, item. 1321);
- Act of 21 March 1985 on public roads (Journal of Laws of 2004. No. 204, item. 2086);
- Minister of Infrastructure Regulation of 31 December 2002 on the technical specifications of vehicles and their scope of necessary equipment (Journal of Laws of 2003. No. 32, pos. 262 as amended.);
- Regulation of the Minister of Transport, Construction and Maritime Economy of 22 June 2012 on permits for oversize vehicles drive (Journal of Laws of 2012, Pos. 764)
- Regulation of the Minister of Transport, Construction and Maritime Economy of 28 March 2012 on the amount of fees for a licence to drive a non-normative vehicle (Journal of Laws of 2012, Pos. 366);
- Regulation of the Minister of Transport, Construction and Maritime Economy of 23 May 2012 on piloting oversize vehicles (Journal of Laws of 2012, Pos. 629);
- Regulation of the Minister of Internal Affairs and Administration of 30 December 2002 on traffic control (Journal of Laws of 2003. No. 14, pos. 144 as amended.);
- Act of 6 September 2001 on road transport (Journal of Laws of 2004. No. 204, item. 2088).

According to these regulations, a permit is not required for:

- buses
- vehicle whose width and length without load is not greater than the limit, vehicle which transports cargo protruding beyond the side, rear and front of the vehicle strokes;
- vehicle involved in rescue operations, and in the immediate liquidation of consequences of natural disasters;
- Management Board of road vehicles, Police, Inspection of Road Transport, Institution of Government Protection, Agency of Internal Security, Agency of Foreign Intelligence,

Institution of Central Anticorruption, Border Guards, Prison Services, Customs Services and fire protection units.

For other vehicles, a licence is required. The licence is valid for a single journey or for the period from 1 up to 24 months. The list of categories, the roads on which vehicles can move, and the period of validity of the authorization can be found in Table 1.

Table 1. List of licence categories.

| category number | Authorization | The road on which the vehicle can move | Validity of authorization (months) |
|-----------------|--|---|--|
| I | The manager of the road | municipal, county, provincial, indicated in the permit | 1, 6, 12 |
| II | Mayor | public, with the exception of expressways and motorways | 12 |
| III | Mayor & Head of the Civil Office | public | 1, 6, 12, 24 |
| IV | The General Directorate of National Roads and Motorways & Head of the Civil Office | national | 1, 6, 12, 24 |
| V | The General Directorate of National Roads and Motorways | public | 1, 6, 12, 24 |
| VI | The General Directorate of National Roads and Motorways | national | 1, 6, 12, 24 |
| VII | The General Directorate of National Roads and Motorways | the route indicated in the permit | 14 days – for single drive; 30 days – for multiple drive |

In order to obtain an authorization for non-normative journeys, the company has to submit an application to the relevant authority. The form for the application can be found in the Annex to the Regulation on the authorization for the passage of oversized vehicles.

Applications for a permit in category I should contain the following information:

- data of the applicant
- date and route of the journey

- data of the transport company

For getting the category II permit, the information presented above, as well as type, brand and registration number of the car performing carriage should be included.

For category III-VI the following information is important to be mentioned:

- length and width of the vehicle,
- if the laden weight exceeds the acceptable level,
- if the axle load exceeds the acceptable level.

Most of the information needed for permission category VII, is information such as:

- number and timing of passes
- data of the vehicle and the trailer: brand and type, registration number, date of first registration, tare weight, load capacity, number of axles
- dimensions and weight of the vehicle with cargo
- weight on each axle and the spacing between the axles

In addition to the application for a permit for category VII, an assessment of the technical condition and analysis of the carrying capacity of the bridges, located on the route, has to be attached.

Samples of all applications can be found in *the Ordinance of the Minister of Transport, Construction and Maritime Economy of 22 June 2012 on the authorization of oversize vehicles drive* or downloaded from the website of the *General Directorate for National Roads and Motorways (GDDKiA)* [1,3].

4. ASSESSMENT OF TECHNICAL CONDITION OF BRIDGES FOR OVERSIZED TRANSPORT LICENCE CATEGORY VII

Bridges are engineered for a normative load, according to the norm *PN-85 / S10030 Bridge Structures*. The loads are dependent on the load class.

If a bridge will be passed by a vehicle with oversized cargo, it is required to evaluate the technical condition and the capacity analysis of the object. Usually they deal with the engineering offices of the branch of roads and bridges.

The technical condition assessment includes:

- periodic inspection protocol, extended by the five-year review of the bridge structure,
- photographic documentation of the object,
- photographic documentation of damages.

The analysis of capacity of the object should demonstrate that the non-normative vehicle will not exceed safe levels of material strength, while going on the road supporting the engineering structure. This can be checked in two ways: by analysing the strength, or analysing the pressure in the structure.

The first method should demonstrate that the internal forces resulting from the oversized load do not exceed the internal forces resulting from the projected load, increased by 30%. In this method, however, we need to know which class of load the bridge has been constructed for.

If we don't know the load class, it requires a more complex analysis which should prove that the principal pressure in the steel does not exceed 2/3 of the characteristic strength of steel, and the principal pressure in the concrete does not exceed 2/3 of the concrete compressive strength.

During the analysis, the degree of damage to equipment as a result of the exploitation should also be taken into account. The factor determining the carrying capacity reduction is considered individually for each object, and should be estimated by the designer by means of experience.

If during the evaluation of the technical condition, there was no such damage as tilting the support, wide vertical cracks on the entire height of the supports, scratches on the body combined with the displacement of the bridgehead wings, holes in the concrete support beams in the zones, or any others resulting in the improper operation of the object, and the calculations showed no contraindications, the transport of cargo, after obtaining a permit, can be achieved [3,5,6].

5. ANALYSIS OF THE CAPACITY OF THE CONSTRUCTION - A CALCULATION EXAMPLE

As it has already been mentioned in point 4, the analysis can be performed by comparing the pressure of the structure caused by the vehicle with oversized load, to the strength of the normative load. It is based on the comparison of the results of internal forces or pressures.

The following example is a very simple analysis of internal forces of a bridge. For this purpose, a calculation model of a fictional bridge

has been created in Autodesk Robot Structural Analysis Professional 2013 (Fig. 2). The dimensions of the bridge were:

- length of spans - $14 + 17 + 14 = 45$ [m],
- usable width - 14 [m].

Then a ballast was applied to a bridge class A (Fig. 3), which includes:

- evenly distributed load $q = 4$ [kN/m²]
- vehicle load $K = 200$ [kN]/axle,

and the oversized vehicle load with a total weight of 152 tons and length (with cargo) of 36 m (Fig. 4). Loads and wheelbase for the vehicle are shown in Table 2.

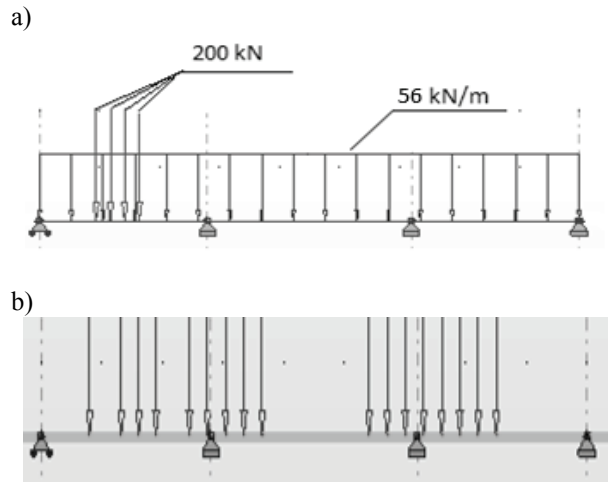


Fig. 3. Load of: a) class A; b) oversized vehicle.

Table 2. Wheelbases and load of the vehicle with cargo.

| Axis number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
|------------------------------------|-----|------|------|------|-----|-----|-----|-----|------|-----|--|
| Vehicle axle load (with cargo) [t] | 7.5 | 7.5 | 10 | 10 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | |
| Distance between axles [m] | 2.6 | 1.45 | 1.42 | 2.75 | 1.5 | 1.5 | 1.5 | 1.5 | 8.82 | 1.5 | |
| Axis number | 11 | 12 | 13 | 14 | 15 | 16 | 17 | | | | |
| Vehicle axle load (with cargo) [t] | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | | | | |
| Distance between axles [m] | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | - | | | | |

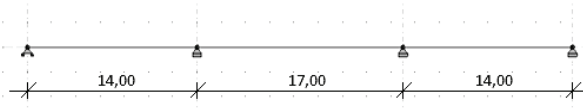


Fig. 2. Calculation model of the bridge.

Based on the calculation, we get the boundaries of the internal forces obtained for all loads. Fig. 4-6 shows the envelopes of internal forces for the load q , K , and analysed vehicle.

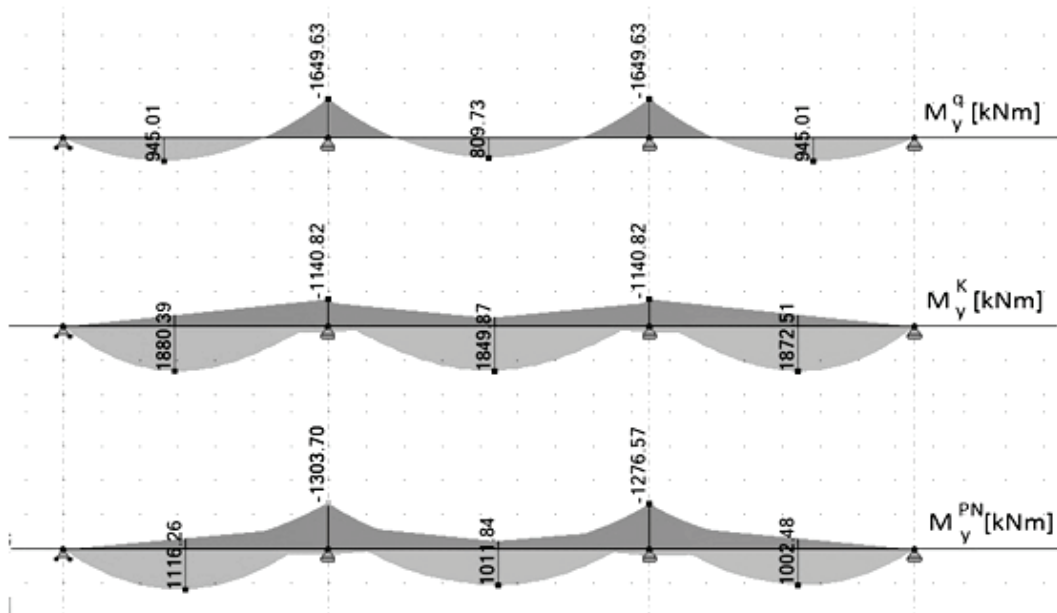


Fig. 4. Boundaries of the bending moments of the load q , K and the non-normative vehicle.

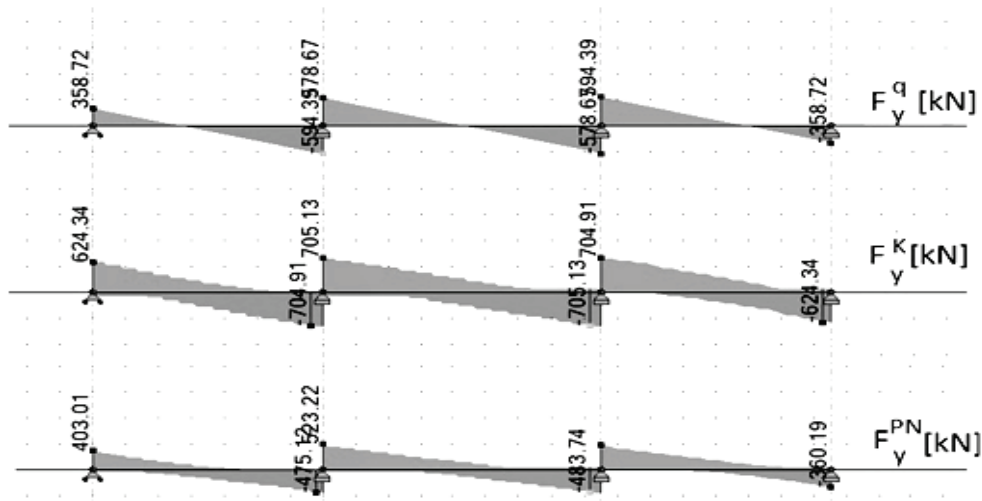


Fig. 5. Boundaries of the shear forces of the load q, K and the non-normative vehicle.

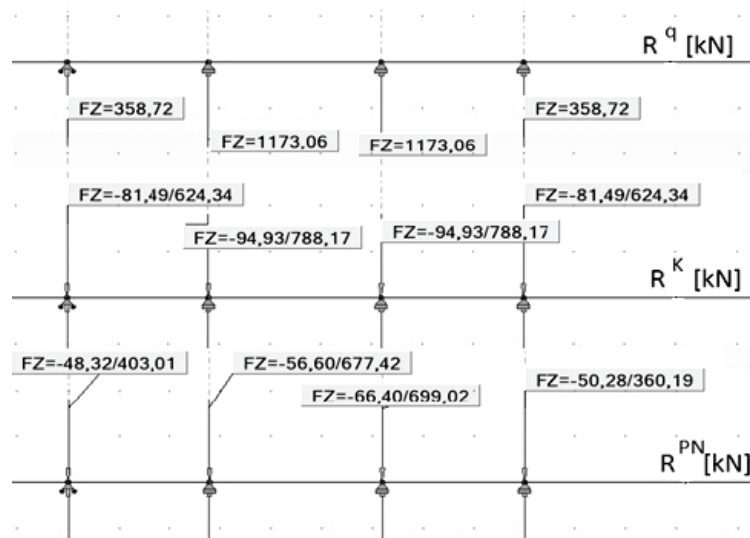


Fig. 6. Reactions caused by load q, K and the non-normative vehicle.

Table 3. Wheelbases and load of the vehicle with cargo.

| Lp. | Load | Bending moments [kNm] | | | Shear forces [kN] | | | Reactions [kN] | |
|-----|------------------------------|-----------------------|------|------|-------------------|------|------|----------------|------|
| | | M1 | M2 | M3 | V1 | V2 | V3 | R1 | R2 |
| 1. | Q | 945 | 810 | 1650 | 594 | 579 | 594 | 359 | 1173 |
| 2. | K | 1880 | 1850 | 1141 | 705 | 705 | 705 | 624 | 788 |
| 3. | Non-normative vehicle | 1116 | 1012 | 1304 | 475 | 523 | 518 | 403 | 699 |
| 4. | Dynamic factor for vehicle K | 1.26 | 1.24 | 1.25 | 1.26 | 1.24 | 1.26 | 1.26 | 1.24 |
| 5. | Strength | 0.38 | 0.37 | 0.51 | 0.38 | 0.41 | 0.39 | 0.71 | 0.39 |

Extract from the static-strength calculations of characteristic load are shown in Table 3.

Verses (1) to (3) include the maximum internal forces in individual spans / supports. Line (4) is a dynamic factor for the vehicle K, calculated with the following formula:

$$\varphi = 1.35 - 0.005L \leq 1.325,$$

Thereby L is the length of the analysed span. Line (5) is the strain of the structure calculated by dividing the sum of the internal forces of loads

q and $K(1 + 2 \cdot 4)$ by the value of the internal forces of the non-normative vehicle (3).

The above presented calculations show that the boundaries of internal forces of loads of the vehicle are contained in the boundaries of internal forces of normative load. The capacity of the bridge is therefore sufficient to transfer the analysed oversized vehicle load across the bridge.

6. ROUTE PLANNING FOR A VEHICLE WITH AN LARGE UNDIVIDED CARGO

To be able to transport an undivided oversized cargo (Fig. 1), the transportation route must be carefully checked. We need to check the condition of roads, dimensions of all crossings on the way and assess whether they allow passage.

The condition to be met for a passage is a suitable technical condition of the road, i.e.:

- lack of landslides on the road,
- gauge height at least 10 cm above the vehicle,
- gauge width at least 1 m wider than the vehicle with cargo,
- evaluation of technical condition of bridges greater than or equal to 3.

If the load is very long, the biggest problem may become the roundabout. Often, if there can't be found an alternate route, it will be adapted to the needs of travel as well as rebuilt, in order to ensure that the vehicle can pass the agent (fig. 7). Due to the increase in the number of oversized cargo in transport, new roundabouts often are designed to easily allow unobstructed laden journey.



Fig. 7. Roundabout adapter for carrying a propeller fan.

However, if the load is very wide, gauge road may not be enough for safe transport. Consequently, traffic signs and traffic lights are

being temporarily removed. Such rides require considerable speed limit and the exclusion of the traffic on the route. This is the reason why such rides usually take place during the night when there is less traffic (Fig. 8).



Fig. 8. Preparation of the route to pass a wide load.

Non-normative vehicles should have adequate red-yellow mark (Fig. 9). Due to the characteristics of the transported good, the driver must hold an authorization to transport oversized loads and waybills for cargo. Carriage is dealt with by professional drivers with several years of experience, using specialized equipment for oversized, heavy and dangerous cargo.

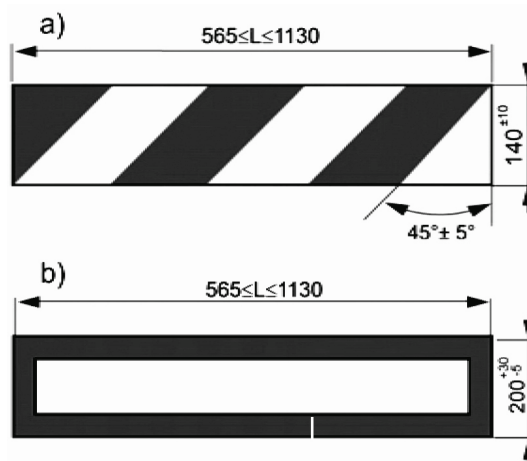


Fig. 9. Designation of oversized vehicles: a) a heavy vehicle; b) a long vehicle.

Oversized vehicles should be assisted by a pilot vehicle (Fig. 10), having a flashing yellow light and being equipped with a special plate, and at least one of the following conditions needs to be fulfilled:

- length - 23 m,
- width - 3.2 m,
- height - 4.5 m,
- laden weight - 60 t.



Fig. 10. The pilot vehicle for oversized transport [11].

The vehicle can safely move through a rail-road bridge, when the following rules are kept:

- the speed is reduced below 10km/h,
- is not allowed to accelerate and brake the vehicle on the bridge,
- passage of oversized vehicles will take place in the axis of the bridge,
- no other vehicles, objects, materials and any measures that may increase load can be present on the vehicle.

After each journey, the transport firm must inspect the structure to verify whether construction conditions have not worsened or if there has been no damage to endanger the safety of traffic [1,3,4,7].

7. SUMMARY

All big investments are associated with the need to transport large, heavy or awkward goods. The transport of oversized cargo by roads has become increasingly popular. Despite the high costs of preparing the transport, roads are more likely to be chosen for transportation of very large components. Travelling on public roads provides faster and more convenient transport than while using waterways and railways. It enables a direct transport from point A to point B, without reloading the goods at railway stations and ports.

Organizing such a passage is connected with the fulfilment of certain requirements, in accordance with the regulations and laws, as it has been mentioned in section 3. If the load is larger, there are more conditions to be met to obtain a permit for the carriage.

There are VII categories of permits. If the carriage is necessary to obtain a permit category VII, in addition to completing the application, you must submit documentation containing an analysis of the technical state of bridges and determine

whether the carrying capacity of the bridge allows a safe passage of the vehicle. In paragraph 5 of this article an exemplary analysis of this bridge can be found, comparing the strength of a bridge under load class A to the strength of the bridge, caused by load of the analysed oversized vehicle.

Although carrying loads of considerable size on mainland has become increasingly popular, a considerable amount of paperwork that must be met in order to be able to take place carriage is still the barrier. Moreover, it takes a lot of time to get the permits and decisions from the authorities. Maybe one day the law enters into force, which will establish rules of travelling and designating routes, by diminishing all the formalities that are needed right now. Today, however, the adaptation of the prevailing regulations is still indispensable.

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