1 Introduction

In Croatia, currently operates over 450 legal entities who are engaged in international freight forwarding business as their primary activity. Many of them are narrowly specialized in road transport, while in port resources operate maritime shippers, and some of them are engaged in rail and water transport. The great concentration of forwarding companies is in Zagreb and Zagreb County because of two key customs offices at the cargo terminal on Jankomir and Žitnjak.

Analysis of the shipping industry in the Republic of Croatia came to the knowledge that reveals the essence of action and activities of the undertakings. Through analysis of the customs in Croatia leads to knowledge that EU funds were spent to modernize it in a compatible system of regulations and guidelines of the EU. It will also analyze the structure and functioning of the new system of customs and forwarding procedures customized to both software and hardware Schengen procedure.

This paper’s topic is the development of shipping activities in the Republic of Croatia, after entering the EU. The fact that a great business endeavor, some restructuring, not only in business but also in the way of business thinking will be necessary for that should be taken to count. Schengen border regime will not be fully applied to the accession of Croatia into the EU, the regime of a transitional period will be established, as it was in Slovenia.

But with regard to new technologies such system will not be needed in a long term and there is concern of the freight forwarders that it will be applied in some areas immediately after the accession of Croatia into the EU. But in this interregnum great efforts will be required of all border services, especially shipping to adapt to inevitable abolition of border crossings and completely new way of doing business at customs offices.
2 Analysis of forwarding services in the republic of Croatia

Structure of companies by ownership and by the size of the company are under the constant influence of the competition value and market efficiency, while private property imposed its effectiveness as a superior form of owner in the developed market economies. In the European Union the number of small and medium-sized enterprises is dominant, which applies to the shipping industry, and these companies are the most represented in the service and family activities. The growth of the companies opens new horizons, but it raises many doubts for their owners. Growth of the companies primarily eludes the possibility of autonomous control and management, and the growth conditions the possibility of separation of managerial and entrepreneurial ownership functions. These dilemmas for some companies resulted in their lower business success, and eventually bankruptcy.

Large and complex systems require a modern organization and management in which management is separated from the ownership structure. The greatest problem for these companies lies is their size, which slows down the organizational changes, and these changes are crucial for a successful business in a competitive market. Large systems inertia also prevents the rapid investment and is therefore one of the basic preconditions for a successful business as fast informatization of enterprises in order to expedite the process, whether it is communicating with its business environment and the practical, administrative premises within the organization.

Small businesses, on the other hand, normally open contractors who have previously worked in large companies and who want to develop some economic activities of a firm in which they are both owners and managers. Very often, the customs clearance is their core business, so therefore it is very important for forwarding companies have good clients who timely meet their customs obligations.

As the forwarding is a service industry, for its functioning relatively low investments are required, while the speed of creating and ROI is higher. The most sensitive is the organizational structure of medium-sized companies in which investments are higher than in small company's (e.g. investment in an own storage area for the purposes of customs clearance of goods).

Regarding to the purchase of large trucks by the forwarding companies that has been proved as a complete failure because of the international road freight transport is very complex process and certainly not compatible with the work of shipping companies as its integral part. Solely because there is overlapping jurisdiction and continuing conflict of interest within the same company.
With stabilization of the political and economic relations more goods travel between European Union and Southeast Europe. In such circumstances, the growth of individual shippers in developed countries was not an easy job, because of the large number of domestic and foreign multinational companies that are present on the market much longer, which well covered the market and reinforced their positions. This situation has encouraged the arrival of freight forwarders from developed countries to Croatia, first as a representative, and with the further expansion of business to opening up a company in Croatia.

3 Croatian customs system

In order to meet its obligations related to the preparation for EU membership, and thus the Customs Administration of the Customs Union, the Customs Administration is working on preparations for the implementation of new systems that will support the implementation of paperless customs procedures. Accordingly, it is necessary to develop and communicate electronically between participants in the customs procedure, i.e. communication between customs and business (G2B service).

NCTS (New computerized Transit System) - is the first system of electronic business in the Customs Administration, which will be applied on a national basis, in order to have this happen as expected, it must be implemented and the electronic exchange of documents between business and customs (G2B service). G2B service is part of the common infrastructure of the Information System of the Customs Administration (IS CU) in charge of IS CU interoperability with business applications on the principles of electronic document exchange.

The Republic of Croatia joining the European Union must assume all obligations under European legislation relating to the Customs Union. One of the areas that will significantly change the business process is a procedure called a transit of goods. NCTS (New computerized Transit), supports the continuous process of transport of goods under customs control as it applied customs administration member states and EFTA countries, and a member of the Convention on common transit procedure and it is the first interoperable trans-European customs system.

Development and implementation of a fully functional NCTS system is one of the basic conditions that the European Commission presents the all new EU members, so that the Republic of Croatia has decided to develop its own national transit applications (NTA - National Transit Application) that supports all the functionality of NCTS. In the European Union, from 1.7.2009 is valid NCTS phase 4.0. This version...
of the system includes procedures for the dispatch, destination and transit customs, and management of guarantees, the process of search and collection, security and data protection. This allows for the electronic receipt and sending of messages that are necessary for the initiation and successful completion of the transit procedure. Full implementation of the NCTS system also includes the implementation of the transit procedure without paper documents. The exception is the only document that accompanies the transit (TAD / TSAD - Transit Accompanying Document / Transit Security Accompanying Document) and serves as a printout of data declarations and the holder of the number of transit procedure (MRN - Movement Reference Number). However, the introduction of NCTS, an electronic record of data only becomes legally valid proof, unlike the current system where it was a paper declaration.

The advantages of the NCTS are multiple, as for customs and for the economy, especially for freight forwarders and authorized senders and recipients, as well as carriers, and other participants in the transit procedure. Communication between NCTS system and companies will be electronically and thus exchange data and information about a specific transit procedure, so it will be timely informed about the progress of this process. On the other hand the CURH data on all transit procedures through electronic message exchange with other European customs administrations, thus allowing a continuous and uninterrupted movement of shipments from the place of shipment to destination.

So, that economic agents pursue the benefits they have to develop their own IT systems compatible with NCTS as well as with external users connect with information systems of customs in a way that allows it to send electronic messages to advance the adopted form and content.

In order to exchange data with companies European Commission is prepared national technical documentation for users, who, along with other business and technical documents were also prepared by the European Commission, assists in the development of NCTS applications for data exchange between customs and external users.

4 Further development of forwarding services in the republic of Croatia after accession to the EU

International forwarding is a complex dynamic and stochastic system, a set of interrelated and interdependent forwarding activities, organizational units, forwarding, forwarding of personnel, technical equipment and other elements in constant motion,
changing and developing. The aim is to transport products from producers to consumers to conduct purposeful, economical and rational way, and that is pushing up to meet the needs of all participants in foreign trade and transport system. Therefore, international shipping is very important economic activity in the system of reproduction (production - distribution – exchange - consumption), and forms part of foreign trade, large-scale international trade and transportation.

Without the construction of a forwarding logistics company, local forwarders would hardly be able to fit into the system forwarding the European Union and the rest of the World. Further globalization of markets, all the more intense competition between the foreign companies, changes in the direction of international flows of goods, changes in the structure of goods (finished products rather than raw materials), less individual rather than the mass delivery of cargo (just-in-time), quality of service that aims to satisfaction of end users, and ultimately providing complete logistics services. All this proves to be an international freight forwarder has to constantly work on improving and expanding its services, and thus an ever stronger and stronger logistical partnership with its customers.

Changes expected after the Croatian entry into the European Union will be reflected primarily in the new IT system and adjusting the customs system of the European Union. Because of the increased responsibilities as a forwarding agent enterprises, shipping companies need to dispose of trained and experienced operational and creative managers who specialize in conducting freight forwarding, transportation, foreign trade, insurance and customs. Only with quality work, forwarders can exclude adverse events and disputes with the customers, which may occur in the organization of dispatch and delivery of goods in international transit. Business experience, knowledge of employees, their ideas, motivation and teamwork are the most valuable part of the capital of modern forwarding company.

In highly developed countries classical and traditional freight forwarders are only historically interesting, because they have been replaced by contemporary forwarding logistics and modern freight logistics operators. In countries in transition and developing countries still exist certain modalities of classical and traditional freight forwarders. They will be in the background gradually suppressed by foreign freight logistics operators. If existing classic freight forwarders in transition and developing countries want to stay and dominate the national transport and economic system, and logistics market, they need to take all relevant activities for the effective transformation into a modern classic freight forwarding and logistics activity.
The logistics provider is registered and authorized legal or private person who on its own behalf and for its own account carries out or arranges for the execution of many logistics activities in connection with the manipulation, transport, transfer, distribution of raw materials, intermediate products, raw materials, finished goods from point of delivery.

The concept of forwarding logistics has the activities of classical and traditional freight forwarders, but logistics part involves other certain activities, such as: the specific service activities in manufacturing, processing, finishing, processing, maintenance of capital equipment, packaging, cataloging, sorting, weighing, measuring load, loading, unloading, reloading, storage items, palletizing goods, further fumigation, pest control, disinfection, custom clearance, insurance, purchase, distribution, marketing, management, calculation, financing, controlling, monitoring the execution of certain activities, the legal regulation of economic relations between the number of participants in logistics processes.

So comprehensively defined forwarding logistics participate with its activities in many types of specialized logistics, such as logistics, manufacturing, trade logistics, transportation, warehouse and distribution logistics. Activities that classic forwarder should take, to be transformed into a logistics forwarding agent are:

- Significantly broaden and deepen the shipping activities in the field of production logistics, trade logistics, transport and transport logistics, warehouse logistics.
- Significantly broaden and deepen the knowledge of its employees, and freight-forwarding and logistics experts. This means not only education and training rather than training them through specialist business schools and courses.
- All forwarding logistics companies need to build a new relationship with all major participants in logistics chains.

In the process of transformation of classical forwarding companies in the logistics forwarding companies, can be determined that a large forwarding companies have fewer requirements and to invest less effort in this transformation, the middle sized forwarding companies have higher requirements, and small forwarding companies have the highest demands of adapting logistics operators.

Strategy of forwarding companies in the European transition countries should be adapted to the strategy of the European Union, so that they can through the national system actively participate in EU trade flows, the European logistics network, the system of rapid land transport and distribution system in express mail on the principles of partnership.
5 Conclusion

In terms of customs and foreign trade there is no category of Schengen border, instead exists outside EU border and the internal borders between Member States. Since the EU is also a customs union at the internal borders between Member States there are no customs control (including any facilities to do so) while the external borders have customs services of Member States who carry out measures of customs control of goods, passengers and transportation services that crossing the external borders. In the future on external border of Republic of Croatia with Republic of Montenegro, Republic of Bosnia and Herzegovina and Republic of Serbia, are not expected or planned no significant elimination of border crossings.

Authorized customs forwarders will be located at all border crossings at the external border in which freight transport is going through. The total volume of forwarding work on these crossings will remain the same or slightly increase until the possible entry of Serbia, Montenegro and Bosnia and Herzegovina to the EU. When these countries enter the Convention on common transit procedure it is expected to be a significant drop in activities for forwarders at border crossings with this/these country/countries.

Establishment of e-customs should not reduce the number of employees at border crossings on the future external border. As a supply chain system is not computerized e-customs will start at the point where the authorized customs forwarders have to enter data and information from paper media in an information system for further electronic distribution of the customs authorities and other participants in the supply chain.

Costs of forwarding documents dictate market and other circumstances. The cost of using forwarding guarantees for transit procedure for movement of goods from Croatia border crossing to the office of destination in any EU (or EFTA) countries will be certainly higher because of greater distance between the forwarding office in Croatia, and destination in the EU and EFTA countries of transit procedures last longer and will be reserved to the sum of these guarantees and will slowly release the required amount, so the reference amount of guarantees for the transit procedure must be higher. It will certainly be an additional cost that shippers will probably charge your customers or users.

From the foregoing it can draw a single conclusion. If the Croatian freight forwarders with 90% of their business based on the placement of the import, export and transit of goods, do not adjust it to the new guidelines in the business, over 80-90% of the current forwarding companies will have to close their business completely
with entering a unified customs process of the EU, which plans to apply to the end of 2012. Accordingly, it will have to be changed a lot of things so far in the general perception of forwarding activities.

References


Resume

In order to meet its obligations related to the preparation for EU membership, and thus the Customs Administration of the Customs Union, the Customs Administration is working on preparations for the implementation of new systems that will support the implementation of paperless customs procedures. Accordingly, it is necessary to develop and communicate electronically between participants in the customs procedure, ie communication between customs and business (G2B service).

This paper represents the processes of transformation of classical forwarding companies in the logistics forwarding companies. It can be determined that a large forwarding companies have fewer requirements and to invest less effort in this transformation, the middle sized forwarding companies have higher requirements, and small forwarding companies have the highest demands of adapting logistics operators.
Strategy of forwarding companies in the European transition countries should be adapted to the strategy of the European Union, so that they can through the national system actively participate in EU trade flows, the European logistics network, the system of rapid land transport and distribution system in express mail on the principles of partnership.

Key words

Forwarding services, logistics, customs

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1 Introduction

Relative to the intensifying and ever-evolving of the electromobility and combined alternative propulsions as hybrids is necessary to know the real possibility of their use in the operation. Efficiency of utilization of these drive systems depends on their right combination and dimensioning. Due to the need to reduce energy consumption and vehicle emissions are currently discovered a systems for the accumulation of kinetic energy from braking that would be otherwise wasted by heat, as well as systems which switch off the combustion engine while vehicle standing, for example on the crossing – Stop&Go system. Proposals similar devices as well as the hybrids usually based on driving cycles - NEDC, FTP and more, for determining of fuel consumption and harmful emissions. These cycles are however simplified and don’t content the grade resistance or real progress of braking deceleration. In contrast, in normal traffic, there is often a short-term braking, respectively slow down, which can be only a minor source of recovered energy. The aim of this paper is to show that the use of standard driving cycles for the design of electric drives, respectively hybrid drives of vehicles is not fully consistent with real conditions. For the purpose of comparison of standardized and realistic driving cycles were performed several measurements of real driving cycles in different cities of Poland, Czech Republic and Slovakia.
Comparison of real drive cycle in the city of Prague and NEDC cycle for measuring vehicle emissions and fuel consumption is shown in Figures 1 and 2. Urban part of NEDC cycle takes first 780 second.

2 Measurement description

Cities with higher population, larger size and more complicated transport system, with the expected use of vehicles with alternative drive systems have been deliberately chosen to measure the real driving cycles. In these cities are a higher proportion of reasons to stop or reduce speed, which is a potential source of re-use of energy. At the
same time the cities continue in solving of issues of environment pollution and reducing emissions from transport.

**Fig. 3 Captions for figures and tables should be written in this style**

<table>
<thead>
<tr>
<th>City</th>
<th>Population</th>
<th>Density [inhabitants/km²]</th>
<th>City area [km²]</th>
<th>Elevation [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katowice</td>
<td>308724</td>
<td>1874,8</td>
<td>164,67</td>
<td>266 - 352</td>
</tr>
<tr>
<td>Wroclaw</td>
<td>632996</td>
<td>2161,7</td>
<td>292,82</td>
<td>105 - 155</td>
</tr>
<tr>
<td>Gliwice</td>
<td>196361</td>
<td>1466,7</td>
<td>133,88</td>
<td>200 - 278</td>
</tr>
<tr>
<td>Prague</td>
<td>1272690</td>
<td>2602,5</td>
<td>496</td>
<td>399</td>
</tr>
<tr>
<td>Žilina</td>
<td>85295</td>
<td>1066</td>
<td>80,03</td>
<td>342</td>
</tr>
</tbody>
</table>

Source: [1]

Since each of the three monitored countries has a different geographic structure it is reflected even in the elevation profiles of individual cities. Figure 3 indicates the basic information of the monitored cities.

Figures 4 to 8 show the elevation profiles recorded during the measurement and compare the elevation profiles differences, which affect the possibility of energy recovery as well as increase the demands on vehicle power unit.

**Fig. 4 Katowice elevation profile**

**Fig. 5 Wroclaw elevation profile**
Because it is assumed that electric and hybrid vehicles will be used for transportation to job and shopping by their owners, the measurements were performed in real time of their use, in the time of afternoon rush hour from 14:00 to 16:30 hrs. This time is characterized by increased number of traffic congestions and longer standing at intersections. By this way were recorded the most energy-demanding regimes of frequent acceleration and braking.

Fig. 9 DAS 3 and contactless velocity sensor
Measurement unit DAS3 (Fig. 9) with contactless velocity and acceleration sensor Microstar Non-Contact 1-Axis Microwave Sensor (Fig. 9) and Corssys Datron Pedal Force Sensor (Fig. 10) for the record of pedal brake pressing were used to record and measure of dynamic quantities. Contactless velocity and acceleration sensor was placed on the side of the vehicle. Values of gradient were determined using the GPS receiver, placed on the front hood of the vehicle (Fig. 10).

**Fig. 10 Pedal force sensor and GPS receiver**

The measuring apparatus was placed on the C-segment class vehicle Hyundai i30 (Fig. 11), with a displacement of 1.4 liters, power of 80 kW at 6000 rpm and torque 134 Nm at 5000 rpm and unlade mass 1286 kg. The vehicle was occupied by two passengers and measuring technology with total weight of 180 kg. Ride regime has been adapted to the surrounding traffic not to avoid its negative influence.

**Fig. 11 Measurement vehicle Hyundai i30**
3 Evaluation of measurements

Figure 12 shows a comparison of typical data of the measured driving cycles as the distance, cycle time, maximum and minimum slope, average speed.

**Fig. 12 Real cycles comparison**

<table>
<thead>
<tr>
<th>City</th>
<th>Max slope [%]</th>
<th>Average slope [%]</th>
<th>Distance [km]</th>
<th>Time [min]</th>
<th>Average speed [km.h⁻¹]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katowice</td>
<td>5,2</td>
<td>-5</td>
<td>1,5</td>
<td>-1,4</td>
<td>12,40</td>
</tr>
<tr>
<td>Wroclav</td>
<td>3,6</td>
<td>-4,9</td>
<td>1</td>
<td>-1,2</td>
<td>18,99</td>
</tr>
<tr>
<td>Gliwice</td>
<td>12,6</td>
<td>-9,3</td>
<td>1,3</td>
<td>-1,5</td>
<td>12,72</td>
</tr>
<tr>
<td>Prague</td>
<td>13,7</td>
<td>-20,1</td>
<td>3,1</td>
<td>-3,5</td>
<td>25,57</td>
</tr>
<tr>
<td>Žilina</td>
<td>5,6</td>
<td>-7,1</td>
<td>1,7</td>
<td>-1,7</td>
<td>23,25</td>
</tr>
</tbody>
</table>

Source: [Authors]

**Fig. 13 Decelerating and driving ratio**

Comparing the five real driving cycles shown that the average time of braking is 13.1% of the driving cycle time as can be seen in a graph in Figure 13. A very small dispersion of these values for different cities is noteworthy. The figure shows that in the city part of standardized NEDC driving cycle, which is mostly used in the design...
of alternative propulsion in Europe, the braking time is up to 20% of the cycle time. Comparing these two figures we can say that the NEDC cycle is considered with up to 35% more time than the average braking time in real driving cycle. Neither the average braking time during real driving cycle does not do a real possibility to use braking to recover kinetic energy, because the function of electric machine do not allow the recovery at low speed.

Currently the most popular hybrid system is called micro hybrid concept also known as Stop&Go system. It is based on the shutting down of the internal combustion engine while standing. The graph in the Figure 14 shows that real standing time is in real driving cycles about as long as the standing time under consideration in the NEDC cycle. Significant differences may be influenced by the complexity of traffic situations and road network in the city as well as by real-time in rush hours.

**Fig. 14 Standing and driving ratio**

![Standing and driving ratio graph](image)

Source: [Authors]
The time of standing useful for Stop&Go system, possible time of recovery kinetic energy from braking and the time of recovery kinetic energy from driving downhill, which is a part of recovery period, can be determined from the measured data about the movement of the vehicle and the signal of brake pedal sensor. The times of using the vehicle standing, braking and downhill braking are displayed in Figure 15.

4 Conclusion

Given the above facts, resulting from the comparison of real urban cycles and the urban part of NEDC cycle results that the design of vehicles designed for driving in urban agglomerations with the possibility of recovery of kinetic energy during braking, it is desirable to take into account the real driving cycle. Real value of the braking time which shows the possibility of energy recuperation is much smaller than in NEDC.

Most of new vehicles are equipped with Stop&Go system nowadays. From measurement data obviously this system has reason and enables decrease fuel consumption and emission. It turned out that the standing time in real driving cycles is close to NEDC cycle. In some cities was almost identical.

References

Electromobility and combined alternative propulsions of city cars are currently topic number 1. In order to be properly designed have to be obvious of their application. It is calculated to use the energy recuperated from braking so that to increase their energy efficiency. Quantity of this energy is usually determined from the NEDC driving cycle. To what extent can the data from the NEDC cycle rely and how they different from data from real driving cycles is the subject of this article.

Key words
Recuperation, NEDC, Stop&Go, real urban cycle, braking, measurement

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TESTING OF LIGHTWEIGHT CONSTRUCTION MATERIALS OF THE TRANSPORT MEANS

Miroslav BLATNICKÝ - Dalibor BARTA

1 Introduction

Development of today's transport means is moving to increasingly lighter constructions. Because of low mass and relatively good material characteristics leads this way very often to use of aluminium constructions. Due to choice of the right material is necessary to know more about his mechanical properties and possibilities of his using. Therefore were done some measurements of the aluminium AlMgSi07 alloy, like detection of the fatigue operating life at multiaxial torsion and bending stress of specimens.

If the material is exposed to the action of the variable forces, respectively to the strain of the supercritical size, after some time there is a fracture (Fig. 1), which is the result of the complicated processes in the structure of the material. The maximal stress value is so low that the material endures its static effect without any damage. Gradual eroding has a cumulative character and is based on creation and spreading of cohesion failures.

Fig. 1 Fatigue damage of the AlMgSi07 alloy

From the observation time of the fatigue failure, like a basic fatigue characteristics is used a Wöhler´s curve (Fig. 2), which shows a dependence between a
stress amplitude of simple symmetric cyclic loading and the number of cycles to the fracture. Wohler’s curve is not a suitable material characteristic for the field of low cyclic fatigue. It is first because of big plastic strains, which leads to the significant difference between values of contractual stress $\sigma_\text{d}$ determined on the basis of the initial cross-section and of the real stress in the sample, second because of small slope of the curve in the studied area. From the practical point of view of fatigue strength calculations are more appropriate characteristics in the field of low cycle fatigue dependence of the amplitude of the total strain $\varepsilon_\text{a}$ from the number of cycles to the fracture $N_f$, which is called Manson – Coffin’s curve (Fig. 3)

**Fig. 216 Wohler’s curve**

![Wohler's curve diagram]

**Fig. 3 Manson – Coffin’s curve**

![Manson-Coffin's curve diagram]

The load of the sample is strain with the constant amplitude $\varepsilon_\text{a}$. The $\varepsilon_\text{a}$ value characterizes the real strain of the sample and is simply measured.
2 The experimental material

The expansive development of the materials helps to the fact that materials on other basis than the iron are constantly more used. The example is replacement of the heavy constructions by the lighter ones, from the materials with lower density. It is for example aluminium and its alloys, which have very favourable ratio of the strength to density and from the terms of the output, aluminium is between non-iron metals on the top in the world. Because of this reason a commercial aluminium AlMgSi07 alloy with a normalised chemical composition was chosen like an experimental material for the carrying out of the fatigue testing (Fig. 4). Testing material was supplied in the shape of rod of circular cross section with a diameter 10mm and length 1520mm. Then it was divided on a bend saw BOMAR 1300 and achieved measure of semi finished product for the production of the testing sample with the length 150mm.

Fig. 4 Normalised chemical composition of the aluminium AlMgSi07 alloy

<table>
<thead>
<tr>
<th>Chemical element</th>
<th>% of the element in alloy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si</td>
<td>0,2 – 0,6 %</td>
</tr>
<tr>
<td>Fe</td>
<td>0,35 %</td>
</tr>
<tr>
<td>Cu</td>
<td>0,1 %</td>
</tr>
<tr>
<td>Mn</td>
<td>0,1 %</td>
</tr>
<tr>
<td>Mg</td>
<td>0,45 – 0,9 %</td>
</tr>
<tr>
<td>Cr</td>
<td>0,1 %</td>
</tr>
<tr>
<td>Ni</td>
<td>-</td>
</tr>
<tr>
<td>Zn</td>
<td>0,1 %</td>
</tr>
<tr>
<td>Ti</td>
<td>0,1 %</td>
</tr>
<tr>
<td>other elements</td>
<td>max. 0,05 each</td>
</tr>
<tr>
<td></td>
<td>max. 0,15 % overall</td>
</tr>
<tr>
<td>Al</td>
<td>remaining %</td>
</tr>
</tbody>
</table>

The geometry of the sample is precisely defined (Fig. 5) and results from the constructional solution to the fatigue testing equipment, in which the testing will be
carried out. Because of this was conveniently used a semi finished product with a diameter of the 10mm without additional necessary treatment of the sample diameter.

Fig. 5 The geometry of the testing sample for the fatigue testing status

3 Testing equipment

The experimental detection of the fatigue characteristics of aluminium AlMgSi07 alloy was performed at a workplace for measurement of the fatigue on the fatigue testing equipment (Fig. 6). Considering the character of the testing equipment, the loading was realized in the controlled amplitude of the strain with zero medium component of the strain.

Fig. 6 The experimental workplace for the measurement of the material fatigue and fatigue testing equipment
Loading mechanisms for the cyclic bending and torsion stress of the sample (Fig. 6) are driven by synchronous servomotors, whose speed is regulated by the inverters up to 100 Hz. The rotational movement of the servomotors is transmitted by the excenter through the force transducer on the crank, which is acting linear motion.

**Fig. 7** A model of stress system for the combination of bend – torsion

4 Measurement of the fatigue life

Input characteristics of the material were experimentally detected from the tension diagram (Fig. 8). To be possible to immediately express the size of the amplitude of the relative strain $\varepsilon_{ac}, \gamma_{ac}$ for the each stress level, it was needed to create calibration dependences (Fig. 9, 10) of the relative strain from the number of excenter teeth, whose change of the relative position by rotation set the size of displacement. The values of the strain were gained by the FEM analyses at all stress levels in the place of concentration of the stresses by the finite element method in the ADINA programme.
Fig. 8 Diagram of the static tensile test performed on the basic material 
AlMgSi07

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E \cdot 10^6$ (MPa)</td>
<td>67.4</td>
</tr>
<tr>
<td>$R_p$ (MPa)</td>
<td>247</td>
</tr>
<tr>
<td>$R_{0.2}$ (MPa)</td>
<td>218</td>
</tr>
<tr>
<td>$A$ (%)</td>
<td>8.9</td>
</tr>
<tr>
<td>$Z$ (%)</td>
<td>19.6</td>
</tr>
</tbody>
</table>

Fig. 9 Values of the strain for the bending stress, material AlMgSi07, $e = 1$ mm
The measurement of the fatigue life of the material on the testing samples, which were cyclic stressed by bending and torsion at the same time was realised after making of the strain dependence of the testing sample. Size of the load was changing.

Because of the fact that the testing equipment enables setting of the mutual phase shift between loadings, it was determined, that the measurement will be realised with the phase shift of 90° (in the moment when the first loading will be in its maximum value, the second one will be zero, Fig. 11) and without the phase shift, when maximal loading will be affect the sample at the same time (Fig. 12). By this step it is possible to observe an influence of the phasing on the fatigue life of the concrete materials.
Because of big amount of the combinations of both loadings (Fig. 13, 14) it was determined, that the combinations will be created on the selected load levels (tab. 2 and 3 highlighted lines). These are characterized by rotating about determined number of excenter teethes towards the excenter body.
Average number of cycles to the breakage on each load level (number of teeth) of the testing sample is shown in the Fig. 15 and 16. The tabs follow that due to the phasing there is a change of the number of cycles to the breakage. At a phase 90° the material endures bigger number of cycles than at a phase 0°. For the verifying of the correctness of experimentally detected results it was used a Fatigue Calculator programme. Fatigue Calculator is program from the internet page eFatigue, where it is possible to easy and quickly makes an estimation of the fatigue life. By this programme we can find out a number of cycles, at which a fatigue breakage happen at a low cycling and also at a high cycling fatigue. Because of the fact, that we have available a possibility to compare the experimentally gained results with the computing, we choose the same conditions of the testing rod loading method – sinusoidal cyclic stress. Values of the stresses, respectively strain in the required units are inserted to the programme from the calculated tensor and it is for $\sigma_{xx}$ respectively $\tau_{xx}$. It works with the symmetric frequency of the loading cycles 30 Hz.
After starting a calculation of the lifetime for the field of low cycling fatigue, the Fatigue Calculator display calculated values of the number of cycles to the breakage with different models of damage like $N_f$ Fatemi-Socie (F-S), $N_f$ SWT, $N_f$ Brown-Miller (B – M) and $N_f$ Liu are.

It is able to see a relatively good match at the phases $0^\circ$ and $90^\circ$ comparing the theoretically and experimentally gained results (number of the cycles to the breakage). Graphically processed numbers of cycles for the experimentally gained values are shown in the Fig. 17 for the phase $0^\circ$ and in the Fig. 18 for the phase $90^\circ$. 

<table>
<thead>
<tr>
<th>Deformation Criterion</th>
<th>$\gamma_{xy}$</th>
<th>$\gamma = 10 \times 10^3$</th>
<th>$\gamma = 8,8 \times 10^3$</th>
<th>$\gamma = 6,9 \times 10^3$</th>
<th>$\gamma = 5 \times 10^3$</th>
<th>$\gamma = 2,5 \times 10^3$</th>
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<td></td>
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<td>490</td>
<td>641</td>
<td>1510</td>
<td>3700</td>
<td>7300</td>
</tr>
<tr>
<td></td>
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<td>510</td>
<td>696</td>
<td>1980</td>
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<td>748</td>
<td>2300</td>
<td>10100</td>
<td>58000</td>
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<td>810</td>
<td>1140</td>
<td>2500</td>
<td>11000</td>
<td>1.43 x $10^6$</td>
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<tr>
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<td>19500</td>
<td>81500</td>
<td>2.43 x $10^6$</td>
<td>1 $10^7$</td>
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<tr>
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<td>$\varepsilon_x = 1,1 \times 10^{-3}$</td>
<td>900</td>
<td>1300</td>
<td>3130</td>
<td>19200</td>
<td>1 $10^7$</td>
</tr>
</tbody>
</table>
5 Conclusion

In the paper, there is described an issue of the measurement of the low cycle multiaxial fatigue of the AlMgSi07 material on the built testing equipment in the bend and torsion. Gained results will be served for the comparison with the results from the experiments for the same but welded material. Part of the paper is also comparison of...
the gained results with commonly used fatigue criterions. The experiment and the fatigue criterions report relatively good match, what is a proof of the correct measuring of the testing equipment and so comparison fatigue life of the basic material with the welded samples will be in addition supported by original testing equipment. The further step will be production and testing of the multiaxial low cycle fatigue life of the welded samples in bend and torsion and also multiaxial low cycle fatigue life at a combination of these stresses.

This paper was created and financing from the grant project KEGA 038ŽU-4/2011.

References


Resume

Increasingly accent on the environmental protection, lower emissions and fuel consumption, are also connected with the reduction of the vehicle mass. Using of light aluminium constructions is the right way to achieve this goal. Due to choice of the right material is necessary to know more about his mechanical properties and possibilities of his using. Therefore were done some measurements of the aluminium
AlMgSi07 alloy, like detection of the fatigue operating life at multiaxial torsion and bending stress of specimens, which are described in this paper. Subject of further research will be the measurement welded sample. The total research result will be the verification of influence of welding on the fatigue operating life of the concrete material at multiaxial bending and torsion stress, which is very common at the vehicle operation.

Key words

Aluminium, torsion, bending, fatigue, measuring

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1 Introduction

Most of the common used commercial vehicles have regular manual transmission, which works with the step ratio change via the so-called range and split transmission gear groups. The tendency is to make the work of the driver less complicated by the automated manual gearboxes (e.g. Volvo I-Shift, Allison gearboxes by Scania, etc.), increasing the efficiency and driving comfort.

The common structure of the drivetrain with an automatic transmission is the power transmission line built in the sequence of the engine - torque converter - automated step gearbox driven by the electromechanical elements - transaxle.

This article presents an unconventional principle of the power flow transmission, different from the commonly used drivetrain. It is a combined hydromechanical transmission with hydrostatic units and torque converter in parallel lines with mechanical components providing the continuously gear ratio change. The mathematical model describing this system is quite complicated, but when correct done, it can increase the quality of the research and development process significantly.

2 System and model structure

The presented transmission contains mechanical parts (gears, shafts, one way clutches), the hydrostatic units and a complex hydrodynamic torque converter. One of the hydrostatic units is regulated via the proportional – derivative (PD) control system, which controls the angle of the unit regulation plate inclination $\beta$. The power flow is divided into mechanical, hydrostatic and hydrodynamic line during the continuously ratio change – the gearbox works as a continuously variable transmission (CVT). It was developed for vehicles with the maximum total engine power of 100 kW. The kinematic structure of the presented gearbox is shown on fig. 1.

After the kinematic and dynamic analysis of the transmission structure was done, the block mathematical model was built. It is based on Matlab / Simulink environment.
The whole model is assembled from partial subsystems represented via calculation blocks.

The mechanical, hydrostatic and hydrodynamic power flow line just as well the electronic control system has its own subsystem block that is connected to the other parts of the model. The diagram of the mathematical block model of the whole transmission system is shown on fig. 2.

**Fig. 1 Kinematic structure of the transmission**

![Diagram](Image)

Source: [2]
3 Simulation principle

The simulation of a vehicle transmission is based on a system response to a load set, which represents the vehicle drive resistance forces or torques. The minimum and maximum resistance torques were calculated according the kinematic structure without the consideration of power losses along the transmission power flow line.

After the simulation of the system response to the constant minimal and maximal load, the step load change was simulated to test the quality of the control system.

The real load changes in the traffic are not so steep, so the robustness of the PD regulator subsystem is tested properly. The load step change is shown on fig. 3.

Source: [1]
4 Simulation results

The initial condition of the simulation progress from 0 to 30 sec. was the engine idle running and the gas – pedal put on 100% by the minimal load applied.

After 30 seconds, in which the gearbox output shaft X reached stabilized speed revolution value, the load steps to maximum and the speed of the output shaft drops significantly. This is the moment, when the observation of the system behavior starts to be interesting.

The achievement of the steady state as a response to the load step in the 30th and 40th sec. is monitored and refers to the quality of the PD – control system changing the $\beta$ parameter of the regulated hydrostatic unit.

The results of this particular simulation are shown on fig. 4 to 8.
**Fig. 4** Speed of the engine crank shaft (m), output gearbox shaft (X) and the gearbox output / input shaft speed ratio

**Fig. 5** The hydrostatic unit regulation plate inclination ($\beta_1$)
Fig. 6 The global efficiency of the transmission ($\eta_c$)

Fig. 7 Torque on the hydrostatic and hydrodynamic transmission parts (M)
Fig. 8 Speed of the the hydrostatic and hydrodynamic transmission parts (n)

5 Conclusion

The simulation of the step changes of the load torque allows to check the behavior of the PD regulation and to consider the change fluency of the observed values according the suddenly load changes. These changes cannot happen so short in the real operation, but they serve a view about the functionality of the hydrostatic control units and thus the whole gearbox by extreme load cases.

By the change of the minimal value of 412 N.m to maximum of 2909 N.m is visible the notable drop of the engine and output shaft speed (fig. 4). The torque converter starts to operate. The engine speed is after about 3 sec. back to the initial value of 2200 min⁻¹ (fig. 4). The hydrostatic unit regulation plate inclination changes fluently, without interferences by the extreme load change. The control system adapts the gearbox operation according to the desired engine speed and the pressure in the low-pressure pipe of the hydrostatic power flow line (fig. 5).

When the load value changes after about 10 sec. back to minimum of 412 N.m, the transmission output shaft speed starts to rise and the engine crank shaft is released. The PD regulation put the regulation plate inclination and also the engine speed to the value at the start of the step change at 30th sec. (fig. 4).

The global efficiency of the power transmission by the minimal load in the stable state is above 0,8 (fig. 6). This is with regard to usage of hydrostatic and
hydrodynamic elements without any ratio step controllers (automated friction brakes, clutches) quite satisfactory. The collaboration between the engine and the gearbox is permanent controlled via the PD controller of the regulated hydrostatic unit.

By the maximum load, the torque converter is still operating. Thus, the global efficiency drops, but that is the consequence of the converter characteristics by the torque multiplication. The hydrostatic power flow line works in the field of power circulation, which is also negative considering the power transmission efficiency value. The torque demand by this working steady state is so high, that the multiplication factor is much more important then the efficiency drop.

The torque and speed of the other particular transmission parts are shown on fig. 7 and 8. The simulation results show, that the PD controller can regulate the value of the regulating plate inclination according the desired engine speed values in the wide range of load cases.

This article is published within the solution of research project APVV-087-10 „Intelligent diagnostic systems of gearboxes and their components”

References


Resume

The article presents simulation results of an unconventional vehicle transmission that can be used in commercial vehicles and mobile working machines. The kinematic structure and the dynamic behavior of the system is extracted into the mathematical model. Thus, the simulation of number of load cases can be done and the control system can be tested without the need of number of prototypes to be built. Also, the model provides the possibility of all subsystem properties editation. This allows to
shorten the development time and to cut the costs in the area of R & D process significantly.

Key words

Simulation, transmission, parallel power flow, mathematical model, control

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VEHICLE SIMULATION POSSIBILITIES

František BRUMERČÍK, Michal LUKÁČ

1 Introduction

Simulation of a road or rail vehicle is a very complex task. There are many possibilities to build the mathematical model according the goals of the simulation. It can be built either as a general full-editable block model, which will cover all possible structures of the vehicle or as a single-purpose model built for the specific structure and its calculation. Every approach can follow to suitable results, but the building and calculating time and work consumption can be incomparable.

2 Simulation possibilities

The simulation of a vehicle can contain many of its components or just a particular part of the complex structure. Generally, the area of the simulation can be understood as in interaction between:

- Driver,
- Vehicle,
- Load,
- Environment.

2.1 Driver model

The driver interferes with the vehicle by the (fig. 1):

- steering (influences the lateral dynamics),
- the accelerator and brake pedals, clutch and gear shifting (influences the longitudinal dynamics of the vehicle).

The driver is gathering the information for his driving decisions from:

- the vehicle (vibrations, sounds, instruments data),
- environment (climate, traffic density, track).
Many driving maneuvers require inputs of the driver at the steering wheel and the gas pedal which depend on the actual state of the vehicle. A real driver takes a lot of information provided by the vehicle and the environment into account. He acts anticipatory and adapts his reactions to the dynamics of the particular vehicle. The modeling of human actions and reactions is a challenging task. That is why driving simulators operate with real drivers instead of driver models. However, offline simulations will require a suitable driver model.

2.2 Vehicle model

The vehicle has to be depicted in mathematically describable substitute systems for computer calculations. The generation of the equations of motion, the numeric solution, as well as the acquisition of data require great expenses. At an early stage of development often only prototypes are available for field and/or laboratory tests. The model of a vehicle contains quantum of particular subsystems. The number of the subsystems and their complexity depends on required accuracy of simulation results and the amount of available input data.

Every part of the subsystem can be described by equations; they fit the function of the technical system into mathematical model by selected level of simplification.

2.3 Load model

The load of the vehicle is mostly represented as a driving resistance in longitudinal direction. The load depends from the vehicle mass, the rolling resistance of the tires, and aerodynamic drag. Then, the simulation is based on motion equations calculated in each simulation step according to possible driving force generated by the
vehicle motor and driver decisions affecting the gas and brake pedal (also gear shifting by manual gearboxes).

2.4 Environment model

The environment influences driver’s decisions by the track profile, the weather conditions (dry, rain, fog, snow – rolling resistance between tire and road), traffic densities (free road, traffic jam, stop and go drive) and traffic rules (traffic lights, road signs, overtaking and turn off rules).

The track can be defined either as a 2D data model (x – z, fig. 1), which can be used by longitudinal dynamics calculations, or 3D data model (x – y – z, fig.1), that can be used by the longitudinal and lateral dynamics calculation. Both models allow to calculate the vertical dynamics of the vehicle (damping).

3 Tyre model simulation example

The task solved in this example was focused on the simulation of an run-flat tyre based on standard ISO driving maneuvers. The model was based on the standard sedan car model platform (fig. 2) in ADAMS/Car software and the results of the simulations are presented below.

*Fig. 2 Standard ADAMS/Car vehicle model*

The simulations were done for 6 types of tyre inflated to 220 kPa and 4 tyres under-inflated to 110 kPa. The configurations files were developed after experimental measurements of necessary relations.
The car behavior was monitored by the prescribed test maneuvers:

- ISO lane change,
- slalom test.

### 3.1 ISO lane change simulation

This maneuver is simulated by the initial velocity $60 \text{ km.h}^{-1}$. The acceleration pedal is held in constant position during the maneuver. ADAMS/Driver is driving just the direction of the car.

The scheme of the overtaking maneuver is shown in fig. 3.

**Fig. 3 Slalom test in ADAMS/Car environment**

The goal of the simulation was to follow the car velocity at the end of the maneuver. The calculation rating was selected by 0.8 according to influence of ADAMS/Driver on the maneuver progress.

Fig. 4 and 5 show the velocity diagrams during the maneuver for the inflated and under-inflated tyres.
3.2 Slalom test

This maneuver is also simulated by the initial velocity 60 km.h\(^{-1}\). The acceleration pedal is held in constant position during the maneuver. ADAMS/Driver is driving just the direction of the car.
The scheme of the slalom maneuver is shown in fig. 6.

**Fig. 6 Slalom test in ADAMS/Car environment**

The goal of the simulation was to follow the car velocity at the end of the maneuver. The calculation rating was selected by 0.8 according to influence of ADAMS/Driver on the maneuver progress.

Fig. 7 and 8 show the velocity diagrams during the maneuver for the inflated and under-inflated tyres.

**Fig. 7 Slalom test velocity graph – inflated tyres**

Source: [6]
Fig. 8 Slalom test velocity graph – under-inflated tyres

Source: [6]

References


Resume

Mathematical modelling and computer aided simulation of technical system virtual prototype behavior is important technique, that influences the effectivity of the machine design process. It is a procedure, which allows to improve the machine design considerable. This method puts the access on the engineer knowledges, that enable to abstract the technical system into mathematical model with reasonable level of simplification. Once the correct simulation model is built, there are wide possibilities of parameter changes without overmuch demand on working and calculation time.

Key words

Simulation, mathematical model, vehicle, ISO test manoeuvres, runflat tyres

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THE ANALYSIS OF BUSINESS PORTFOLIO OF PUBLIC WAREHOUSING

Eva BRUMERČÍKOVÁ, Bibiána BUKOVÁ, Nina KUDLÁČKOVÁ

1 Bonded warehouses in public warehousing companies in the Slovak Republic

Important service in the logistic warehouses is the possibility to store goods in bonded warehouses. Overview of bonded warehouses in public warehouses in the Slovak Republic you can see in the Table 1.

*Tab. 1 Bonded warehouses in public warehouses in the Slovak Republic*

<table>
<thead>
<tr>
<th>Region</th>
<th>Bonded Warehouse</th>
<th>Region</th>
<th>Bonded Warehouse</th>
</tr>
</thead>
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<tr>
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<td>PR</td>
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<tr>
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<tr>
<td></td>
<td>over 10 000 m²</td>
<td></td>
<td>over 10 000 m²</td>
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<tr>
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<td>Together TNR</td>
<td>3</td>
</tr>
<tr>
<td>KR</td>
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<td>TTR</td>
<td>0 - 999 m²</td>
</tr>
<tr>
<td></td>
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<td>1 000 - 4 999 m²</td>
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<tr>
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<td>Together SR</td>
<td>32</td>
</tr>
</tbody>
</table>

Source: [6]
Total share of public warehouses with bonded warehouse is in the frames of the Slovak Republic about 7.92%. The biggest part of all public warehouse companies providing service “storage in bonded warehouse” has the region Trnava in concrete it is 8.33% from all 96 public warehouses in the Trnava region. On the second place is the Bratislava region with 7.27% share. In the Žilina region and in the Prešov region is the possibility of storage in bonded warehouse not realized. In Košice region there are only 4 public warehouses providing above mentioned services. Surprising is the fact that the Košice region together with the Prešov region (which has no public warehouse with possibility to use the bonded warehouse) make up the eastern borderline of the European Union.

2 Usage of railway transport in public warehousing companies in the Slovak Republic

The role of the Transport Policy of the European Union is the support of building and modernization of logistics centres which provide also railway siding in order to move part of transports from the road transport to the environmentally advantageous railway transport. Table 2 shows providing of the railway siding in public warehouses in the Slovak Republic.
### Tab. 2 Public warehousing with the railway siding

<table>
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<tr>
<td>TOGETHER SR</td>
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Source: [6]
It follows from the picture how low is the number of public warehouses using the railway siding. The most is the railway siding used in the Košice region the share is about 40% of all Slovak Republic. In the second place is the Žilina region where about 20% of all public warehouses operate the railway siding. In the Bratislava region we can find 165 public warehouses but only 4 of them operate the railway siding which is about 2,42% share. From comparison with other regions we can see that the Bratislava region is the one with it lowest number of public warehouses providing the railway siding.

3 Conclusion

It followed from the analysis that providing of bonded warehousing in public warehouses is minimal in the process according to statistic information the import has in the Slovak Republic (except the year 2009) increasing tendency (see Picture 3). The trend line with the highest probability (about 63, 6 %) you can see in the Picture 3. In accordance with this trend line the import will continue to growth.
Continual increase of railway transport demand increase production of greenhouse gases. Freight transport causes up to 87% of all total volume of emissions to air. It follows from above mentioned and also from the Transport Policy of the Slovak Republic and of the European Union that using the railway transport should have increasing tendency.

On the basis of realistic scenario the supposed development in the transport area to the year 2020 should be following:

- the number of transported goods and so transport outputs will in general increase and the road freight transport will hold the dominant position,
- increase of the railway freight transport will find expression mostly on main corridors as a result of the trade globalization
- the share of intermodal transport will progressively increase – from present 2.3 million tons to more than 8 tons to the year 2020; the most will increase the transport between European Union and Asia by the force of transportation containers,
- influence of globalization in the international trade will find expression in progressive increase of number of transported goods about 42% to the year 2020 and about 50% compared to the year 2008,
- development of freight transport will considerably influence the level of infrastructure and the connection to the TEN-T, the level of interoperability
and the level of using information and communication systems based on the logistic access and global navigation services.

**Tab. 3 Prognosis of chosen modes of transport share according to the transportation outputs (in ton-kilometer)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Railway Transport</th>
<th>Road Transport</th>
<th>Water Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>9463</td>
<td>22550</td>
<td>680</td>
</tr>
<tr>
<td>2010</td>
<td>7885</td>
<td>30115</td>
<td>923</td>
</tr>
<tr>
<td>2015</td>
<td>8198</td>
<td>36583</td>
<td>1183</td>
</tr>
<tr>
<td>2020</td>
<td>9836</td>
<td>41194</td>
<td>1850</td>
</tr>
</tbody>
</table>

*Source: [6]*

**Fig. 4 Prognosis of chosen modes of transport share according to the transportation outputs (in ton-kilometer)**

*Source: [7]*

**References**

Resume

Warehousing is an important and integral article of logistics chain. Warehouses and transport are a significant proportion of the total logistics costs. The role of warehouses in the logistics chain is necessary to analyze in terms of functions and the costs.

In the article will be analyzed public warehousing of Slovak Republic on this criteria:

- Analysis of public warehouses in their business portfolio,
- Analysis of public warehouses in the using of rail transport.

Key words

Warehouses, business portfolio, rail transport, analysis
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THE CHOOSING LOGISTICS CENTERS IN AUSTRIA

Iveta KUBASÁKOVÁ, Katarína IVÁNKOVÁ

Austria is a very attractive environment for investors and entrepreneurs; the capital Vienna features a highly trained and large workforce and is firmly linked to transport infrastructure. Austria is located in an excellent position, linking Southern and Eastern Europe. Vienna Airport is ideally located in the heart of Europe and leases more than 50,000 m² of office space and storage facilities covering 37,676 m². Logistics center investments are also directed to the port of Vienna while the port itself annually clears about 12 million tons of goods and is one of the leading logistics centers in Central and Southeastern Europe. [13]

1 Süd Graz Logistics Center

The Graz Cargo Center has become a major logistics hub for the southeastern portion of the European Economic Area since opening in 2003. International transport companies and freight forwarders find over 110,000 m² of modern warehousing space for storage as well as finishing and packaging of goods of all kinds, and two intermodal facilities with all intermodal transport services. KLV-systems represent the core of the freight traffic center and include two gantry cranes and mobile equipment used in the most efficient block train facility in Austria. Here, every day some 300 trucks and 10 to 12 trains are dispatched with over 3,500 tons of freight. Maximum storage capacity is 1,800 40' containers, which can be directly controlled from the crane or one of three reach stackers.

Reefer service, customs clearance, container repair service truck and a gas station for the terminal help make this logistics center a powerful partner in the European freight network.

Technical parameters:

- Total capacity: 150,000m²,
- Warehouses: more than 110,000 m²,
- Office space: 13,000 m²,
- Container storage: 80,000m²,
- Two gantry cranes for containers, mobile equipment,
• Daily capacity of up to 300 trucks,
• Maximum capacity of 1,800 40’ containers,
• 10-12 block trains a day, 4 with length of around 700m.

Services:
• Block train assembly,
• Rail access to storage areas,
• Petrol station,
• Container cleaning and cleaning services for cargo wagons and trucks,
• Classification of goods,
• Container repairs,
• Customs services,
• Container rentals,
• Temporary storage of hazardous goods and containers,
• Agency consulting services.

2 Port of Vienna (Hafen Wien)

The port of Vienna has an area of 3.5 million m². The Wiener Hafen Group is a part of the Wien Holding Group and with its subsidiaries it operates three large cargo terminals including ancillary infrastructure: the Freudenau harbor, Albern harbor and Lobau oil terminal. These three harbors handle around 1,700 cargo vessels a year. The Danube is used in particular to transport petroleum products, road salt, building materials such as cement, sand and steel products and to transport agricultural products such as grain and fertilizers. The passenger terminal close to Reichsbrücke Bridge and the Vienna marina are also in the Wiener Hafen Group.

The port of Vienna is the largest port on the Danube in Eastern Austria and its diverse logistics capabilities and capacities continue to be enlarged. Although it is 2,000 km from the Black Sea and 1,500 km from the North Sea, it has the great advantage of being the largest tri-modal logistics center in Austria, bringing together road, rail and water transportation and making it the ideal place for the transportation of goods and container storage, trade and management.

The port of Vienna handles 12 million tons of freight annually, 50% by road, 35% by rail, and 15% by river. Some 60,000 trucks were handled in 2008. Every week 85 container trains travel to the major European ports such as Hamburg, Bremerhaven,
Rotterdam and Duisburg, or to the Eastern European hubs of Bratislava and Budapest. This makes the port of Vienna a central interface for overseas container traffic, which will be further developed through additional rail connections to Cologne and Sopron.

In addition to Wiener Hafen Group companies, there are over 120 other firms that utilize the excellent infrastructure at the port of Vienna freight traffic center. This provides 5,000 jobs to Vienna and in 2008 a total of 12 million tons of freight were handled. [14]

Services:

- High-rack storage,
- Block storage,
- Cold stores and deep freezer storage,
- Cross docking,
- Order picking,
- Packing,
- Loading / unloading of containers,
- Stuffing / stripping,
- Customs clearance and transports,
- Other services on request,
- Washing facilities,
- Removal of protective covering,
- Vehicle workshops,
- Halls for cleaning vehicles and installing radios, spoilers and other accessories,
- Petrol station,
- Railway tracks for 50 vehicle transport cars,
- Ro-Ro facility, etc.

Technical parameters:

- Covered warehousing: 70,000 m²;
- Open-air storage capacity: 200,000 m²;
- Space for 10,000 vehicles – 160,000 m² covered storage for 2,600 vehicles;
- Cranes with lifting capacity from 6 t to 160 t, mobile excavators.
Container terminal: 60,000 m² with capacity for up to 5,000 TEU; storage for all types and kinds of containers.

The port also offers attractive office space at the river and employs more than 5,000 workers, making the port a major employer in this area of Austria.

3 DB Schenker Salzburg

On 5 October 2010 DB Schenker opened the most modern land transport terminal to date, which is now connected to the rail network. This €26 million logistics center, which opened in Salzburg in April, serves as a hub for flows of goods in Europe and now links road and rail.

The roughly 80,000 m² site is home to a 10,000 square meter transshipment hall, a 4,250 m² logistics hall and an almost 5,000 m² office building. Rail transport is seamlessly integrated into the logistics solutions thanks to the terminal’s dedicated siding, which connects the terminal to the rail network.

Policymakers and representatives from the business community were on hand as DB Schenker and the local rail company Salzburger Lokalbahn dedicated the siding. The track is 414 meters long and connects the terminal in the Bergheim District to the existing route in the Aupoint industrial area and on to the European rail network.

"Now that the siding is connected, our terminal is a fully fledged intermodal hub. We offer customers full rail services whenever rail is appropriate for the customer’s consignments," said Karl Nutzinger, Member of the Management Board of Schenker AG responsible for Land Transport.

All types of rail transports can be integrated seamlessly into logistics concepts via the siding with a covered loading ramp. "Rail is an ecological and economical alternative for forwarding certain types of goods over long distances. We link rail directly to pre-carriage and onward carriage by truck and our warehouse concepts without intermediate transport," said Elmar Wieland, Chairman of the Management Board of Schenker & Co. AG, Vienna, responsible for Southeast Europe, highlighting the wealth of available options. All variants are accessible at the Salzburg facility, from single car transports and combined transports on up to block trains. The terminal also has equipment for loading paper rolls. Salzburg serves as a pulp and paper competence center for DB Schenker in Austria and has decades of experience in these product areas. Freight with a unit weight up to 7.5 metric tons can be transshipped to rail in other product areas as well. [2]
ATG Autotransportlogistic GmbH (ATG) and Schenker Automotive RailNet GmbH (SAR) are merging. In the past they were managed as two separate companies within DB Schenker Rail.

(Mainz/Eschborn, 5 October 2010) The two companies will now be managed as a single unit. "By merging the two companies, we hope to increase our efficiency in serving our customers in the automotive sector. The merger is a response to the industry’s greater demand for integrated network solutions for components as well as finished vehicles from a single source," says Karsten Sachsenröder, Member of the Management Board of DB Schenker Rail responsible for sales.

The new company, called DB Schenker Rail Automotive GmbH, has been registered in the Commercial Register since September 15th. Both companies’ sites and organizational structures are expected to be merged and a new corporate identity introduced in the first quarter of 2011. [1], [8]

DB Schenker Rail Automotive GmbH will continue to be managed by the Automotive Market Unit at the Europe level of DB Schenker Rail. It comprises four divisions. The head of this Market Unit is Axel Marschall, who is responsible for comprehensive business development and coordinating cooperation with fellow European sister companies as the Chairman of Business Management. The Finished Vehicles Division (formerly ATG) will be headed by Managing Director Peter Büsing; Components (formerly SAR) will continue to be managed by Managing Director Jens Nöldner. Arthur Meurer will serve as Managing Director for Finance and Controlling.

Sales and dispatching structures for finished vehicles and components will remain separate to satisfy different purchasing behaviors, customer contacts and their specific features. The new structure will ensure business neutrality through third-party forwarders for the finished vehicle business.

With over 200 trains a day and over three million finished vehicles a year, automotive transportation logistics from DB Schenker Rail is the market leader on European railway tracks, generating sales of around €650 million in 2009.
Services:
- Evaluation of suppliers,
- Assembling, reassembling, modifications etc.,
- Expedition 24 hours a day,
- Nationwide distribution,
- JIT – supplies routing,
- Container storage and rentals,
- Cleaning,
- Maintenance,
- Customs services.

It offers capacity for 3,000 TEU, 5 railway tracks totaling 530 m and one 280 m track. The logistics center, along with the terminal is located in the Schenker European network which connects Milan, Paris and Friedewald, and is one of the central business hubs. Its excellent location provides quick access to Europe. [7]

DB Schenker has a whole network of logistics centers in Austria, one of many being available in Innsbruck. Direct connection to the rail network is also a great advantage and the logistics center includes a container terminal that provides standard services. A less-than-5,000 m² warehouse offers more than 2,800 pallet spaces. There is another small picking warehouse with an area of 900 m². [13]
4 Conclusion

Logistics centers ensure the flow of a large quantity of goods in particular between subcontractors and producers and between producers and final consumers.

The task of retail chain logistics centers is to ensure the continuous operation of large retail networks through supplies. These centers are built in east to access locations, especially near motorways or motorway feeder roads. Financing for such real estate is usually ensured from internal funds or a bank providing corporate financing based on group creditworthiness.

Construction of modern logistics centers in Slovakia began to develop more markedly in the period when Slovakia first appeared to foreign investors as an interesting destination for business activities. During this period, Slovakia saw the
gradual expansion of foreign chains as well as the entry of foreign investors who have brought along networks of subcontractors.

References


[10] www.mlbkt.hu


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I/2012
Resume

Logistics centers ensure the flow of a large quantity of goods in particular between subcontractors, producers and producers and final consumers. This article was written about logistics centers which are choose from all logistics centers in Austria. There are centers as a Graz logistics center, Port of Vienna (Hafen wien) and DB Schenker Salzburg. In the end of this article is map with logistics centers in Austria and its allocation in territory of Austria.

Key words

Logistic center, logistics services, transport services, customer, capital.

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1 Integrated transport systems and the development of area

The integrated transport systems are the successful solution for improving the situation in the modal split in many countries in Europe but also in other countries around the world. They offer the integrated system including transport and tariff integration for the passengers. It means the passengers do not have to realize that they travel by different transport modes or by different public transport providers. The integration means a better quality of services, easier orientation in the whole system for regular and also irregular passengers, the system is more comfortable. The passenger perceives the system as the one united organization in which he can change the transport modes without necessity to buy a new ticket.

Usually the integrated transport system includes the urban public transport, regional bus transport and regional railway transport (but also e.g. river transport can be including, for instance in Prague integrated transport system).

Each of integrated transport systems operates on the different area with a different number of inhabitants, with different geographical conditions, with different history in developing of transport systems. All these factors have to be included in the process of planning and developing the integrated transport system on some area.

The form of transport networks and form of area development has to be considered as the impact on the mobility. The significant changes in the spatial planning have the big influence on the demand for transport and modal split. The integration should be considered in the first steps of preparation of regional and urban spatial planning.

In the last years many changes have been done regarding to the development of areas mainly in the cities and their surroundings. The new plants, logistics centers and parks, supermarkets were built which has caused the changes of journeys of inhabitants. Also we can see that people have started to move from the cities to the suburbs areas. The new satellite villages have become built because they are close to
the cities but there is the advantage of living in the calm area in the house in the village. Regarding to all these changes and to the fact that the people have the better financial conditions, they have started to buy and use more cars for their regular journeys what has the influence on decreasing number of passengers in public passenger transport.

All these changes have caused the changes in the journeys of inhabitants – the number of journeys, the distances of journeys and the direction of journeys. All these changes should be analyzed before planning the integrated transport system on some area. These changes have the influence on the travel demand from the perspective of urban planning.

The spatial planning characteristics which are important according to travel demand have been characterized as the “3 Ds” including density, diversity and design. Later they have been extended as the “5 Ds”, covering density, diversity, design, distance (to public transport) and destination accessibility. [1]

\[
\textit{Tab. 1 Strategic and local themes and 5Ds}
\]

<table>
<thead>
<tr>
<th>Strategic themes</th>
<th>Local themes</th>
<th>5 Ds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settlement size</td>
<td>Density</td>
<td>Density</td>
</tr>
<tr>
<td></td>
<td>Jobs-housing balance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accessibility to key facilities</td>
<td></td>
</tr>
<tr>
<td>Strategic development location</td>
<td>Development site location</td>
<td>Design</td>
</tr>
<tr>
<td></td>
<td>Mixed use</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neighborhood design and street layout</td>
<td></td>
</tr>
<tr>
<td>Strategic transport network</td>
<td>Travel demand management</td>
<td>Distance to public transport</td>
</tr>
<tr>
<td></td>
<td>Parking</td>
<td>Diversity</td>
</tr>
</tbody>
</table>

Source: [1]

It can be seen (table 1) how the area and its characteristics are connected with planning and modeling the transport including the public transport.

When we realize these 5 Ds in the context of integrated transport system and its connection to the spatial modeling and planning, it can be said how they influence the integrated transport system.
1.1 Density

The settlement density of some area influences the directions of journeys, the distance of journey but also it has the impact on the type of tariff system which will be used in integrated transport system. This influence can be seen on the example of Tyrol integrated transport system. The area of Tyrol (Austria) is covered mainly by mountains. The settlements are in the valleys. This was the important factor for decision to choose the zone tariff system with zones in the form of honeycomb. These zones cover the roads and so lines of public transport on them.

**Fig. 1 Tyrol area**

![Tyrol area](source: [8])

**Fig. 2 Honeycomb zones of integrated transport system of Tyrol**

![Honeycomb zones](source: [5])
It is known that the one of the aims is to provide equality of tariff system for passengers by using the tariff arrangement of area. This is the key role from the economic point of view for passengers and their expectations to travel by public transport for reasonable price. The choice of appropriate tariff structure with regard to density and following costs resulting from the division of area and from the number of crossing zones by passenger is very important part of planning process of integrated transport system.

1.2 Destination accessibility

„Integrated planning means that land use and transport policies can be pursued as a series of coordinated initiatives. “ [1]

The good accessibility to get to the destination of inhabitants activities is necessary to be provided and it is very important part of spatial planning as well as transport planning considering the operation of integrated transport system on the area. It can be said that it is – together with travel costs – the key factor for inhabitants for deciding if they will use car or public passenger transport. In the process of integrated transport system planning this high impact of final transport coordination to the decisions of passengers has to be realized and considered.

The role of integrated transport system is to provide the good accessibility which can be competitive with use of car. The accessibility can be perceived from two points of view [3]:

**Time accessibility** – generally time accessibility is defined as the accessibility of stops, city centers or areas (villages, towns). When considering the time accessibility and integrated transport system, priority is the time coordination between involved transport modes to be done with aim to provide the connection between the place of origin and destination in shortest time. This travel time consists of time of traveling and time of transferring. Just the time of transferring between two lines (regardless of two lines are of the same transport mode or two different transport modes) has to be as short as possible and the passengers do not have to wait.

**Spatial accessibility** - the accessibility to the journey destination. The destination can be reached with or without transfer. When the transfer (one or more) is needful, the place of transfer (terminal) has to be the place for safe transferring with all important information for passengers about lines, directions, times, delays, etc.
1.3 Design

The transport integration in the process of integrated transport system planning includes the time and spatial coordination between different transport modes which are operated in the area and the system optimization. Each of the unintegrated transport systems has its own transport network. The density of transport network depends on the role of transport system on the area.

The design of integrated public transport has to result from the situation before integration but has to optimize the lines because of time and spatial coordination.

The one of the very important steps is to define which of transport modes will be a bearing (backbone) system and which one the additional system. There can be three possibilities:

- The current situation will be maintained – the systems which will be included into the integrated transport system will have the same position in ITS mutually, no principled changes.
- The position of some of systems will be enhanced in relation to another system – till the integration all the systems on the area have the same position in serving of area. It can be said that each of systems has its own parts of area on which it is operated. In the process of integration the one system is enhanced by increasing the number of lines or the length of lines, the extension to other areas. It already requires some investments and larger changes.
- The new system is chosen as the bearing system – it includes much extended changes and it is associated with the large investments. Usually the new system is developed and built to be the main system for serving the area. The other systems are the additional systems.
The integrated transport system in Košice can be used as an example of the second possibility. This ITS is now in the preparing process. In 2010 the company ORID (Organizátor regionálnej integrovanej dopravy / Organizer of regional integrated transport) has been established. This company provides now the elaboration of project documentation for transport buildings which will be built within the Operational Programme Transport 2007 – 2013. It includes the projects as e.g. the terminal of integrated passenger transport in Moldava nad Bodvou town (figure 3), the electrification of railway line Haniska near Košice – Veľká Ida – Moldava nad Bodvou town, terminals of integrated rail transport in more parts of Košice city. [3]

The design of integrated transport system has to consider also the changes in the journeys of inhabitants caused by development of area. The new plants, logistics centers and parks, supermarkets were built which has caused the changes of journeys of inhabitants. Also people have started to move from the cities to the suburbs areas. The new satellite villages have become built because they are close to the cities but there is the advantage of living in the calm area in the house in the village. Regarding to all these changes to the fact that the people have the better financial conditions, they have started to buy and use more cars for their regular journeys what has the influence on decreasing number of passengers in public passenger transport.

All these changes have caused the changes in the journeys of inhabitants – the number of journeys, the distances of journeys and the direction of journeys. All these changes should be analyzed in the process of integrated transport system planning. These changes have the influence on the travel demand from the perspective of urban planning.

1.4 Distance to public transport

When the passenger decides to use the public passenger transport, the distance to public transport is another important factor for his decision. It includes the accessibility (time and spatial) to [3]:

- the transport network as such,
- the stops, terminals.

In the both cases it depends on the area from which the passenger wants to travel to the destination of his journey and on the density of network of transport modes operated in the area.
The network of each transport mode has a different extension and so the access is different for the inhabitants in the area.

On the base of the accessibility to public transport network we can divide the inhabitants into the following groups:

- Inhabitants of towns, cities – good access to the transport network regardless of transport mode.
- Inhabitants of small towns and villages – access to both bus and railway transport.
- Inhabitants of towns and villages – access either to bus or railway transport. Considering the density of network (figure 4) the most villages are serviced by bus transport.

The accessibility to public transport network influences the necessity to change the transport modes and so the planning of whole system including the transfer nodes.

1.5 Diversity

The diversity of land means the use of land for retail, service and other activities. [1] It is another factor which influences the journeys of inhabitants and has to be considered. It can be said that the factors density and diversity give the social-demographic view on the use of area; they are influencing each other and have to be analyzed when the integrated transport system is in planning process. Because of permanent development changes of area and its use the analysis have to be done constantly.

2 Conclusion

When the integrated transport system is planning, the pre-integrated state of public transport on the area has to be analyzed in detail. The key impact factors as...
density of settlement, diversity of area use, development changes have to be identified too. They influence the design of ITS, the transport and tariff coordination, the whole structure of integrated transport system and its subsystems. Because of area development changes, analysis of these changes have to be done permanently also during the operation of integrated transport system. These changes can have a strong impact on the journeys of inhabitants and so they can influence the use of public passenger transport (ITS) and so the transport modal split.

References


Resume

The paper deals with the planning of integrated transport system with regard to the area on which it will be operated. The system will integrate the different transport modes on the area with its special social-demographic characteristics (density, accessibility to destination, to public network, diversity of land use, etc.).

Key words

Integrated transport system, public passenger transport, density, accessibility, distance, design, diversity
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