Alternative solutions of high-speed railway connection between Prague and Brno

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**Abstract:** The paper deals with proposal of alternative solutions of high-speed railway connection between Praha and Brno. In the introduction the importance and contribution of high-speed lines is referred. In the other part the genesis of alternative solution proposal is reminded and there is a comparison of travel times for different trains. In the following part simplified project of proposal rout of high-speed line is presented. Part of this paper also deals with traffic demand in relation Prague – Brno and approximates investments and operation costs. In the end the need of high-speed lines construction in the Czech Republic is accented. There are submitted possibilities of alternative solution with synergic utilization of corridor line with favorable routing parameters and new high-speed line.

**Key words:** high-speed line, alternative solutions, genesis of alternative solution, proposal of route, travel times, traffic demand, approximate costs

**Introduction**

Higher-speed and high-speed operation is condition of competitive strength of European railway transportation and it is guarantee of constantly sustainable status of solution of growing demand for fast and pleasant transport at median and mainly at longer distance. Aspects of operating safety and energetic and ecological acceptability are implemented. European transport and economist authorities are consistent with that. And it confirms still increasing total length of high-speed lines (HSL). HSL in sequence at reconstruction and innovation existing lines gradually produce Pan European railway network of 21st century.

**1. Genesis of alternative solution**

Above mentioned trend and needs were recognized also in the Czech Republic at eighties and nineties. The studies was prepared, whose result was the proposal of route HSL between Prague and Brno and it was issued building ban on area concerned. Independently of these studies the group of experts of Jan Perner Transport Faculty (JPTF) was established. This group of experts was focused on searching of a concept of minimal capital-intensive solution with maximum available effect in earliest time period. The approach selected by foreign

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railway authorities in many cases – suitable combination of reconstruction existing lines and newly built high-speed lines only in sections where existing line presents unsolvable speed limitation was explored. The first outline proposal of solution in 1995/96 arose this way [1]. JPTF worker’s will to participate on the solution of these problems results came out from gained experiences by research activities within the frame of complex state research project “Escalation of speed on railways in ČSSR” at former Transportation university of Žilina in beginning of seventies. In 1973 it was reached significant speed record at today’s Czech Republic territory by repetitive ride at speeds of 200 – 205 kph. This record was reached by solution of partial problem of aerodynamic effect to objects in closeness of track rolling by higher speed. In 1995 1st international colloquium for objective evaluation of cited first solution was organized at JPTF. On this colloquium there were participated not only Czech experts but also French and German experts. After that the tabled first solution was specialized and it was realized some else presentation and discussion forums. The last colloquium, organized in 2001, about this subject presented consistent view of analyzed problems with consideration on previous suggestions, which flowing from foreign expert’s experiences. Negotiated paper [2] was argued with expert – DB AG workers [3]. It was reported on partial problems and pieces of knowledge on international conferences [4] too. Since 1999 till now the study project in frame of design oriented education at Transport Faculty of Czech Technical University in Prague is proceeding. Ten students worked for its solution and it was elaborated six theses till this time.

2. Comparing of travel times

Analysis of speed conditions on the first national (4th European) railroad corridor after its finished reconstruction was based of proposal alternative solution. The result was finding that the section with minimum specifically defined fictive average speed for standard-car-trains is 115 km long section between Choceň and Brno. At this section is that speed only 100 kph but at other sections the speed increases up to 150 kph with potential possibility increase the speed more because at these sections is favorable geometric parameters of route. And actually total length of others section is almost triple than between Choceň and Brno. Pendular trains (with active tilting) using increase fictive average speed only at 115 kph at mentioned restrictive section. It is possible to eliminate the recognized inhomogeneous of speed profile by bypassing the critical section by 92 km long new-construction HSL. This solution not only accentuates advantage sequent on capital-intensive reconstruction of better part of 1st corridor but it also abridges a distance between Prague and Brno about 23 km. This solution also creates prerequisite for strong increase of average speed at minimized budget of investments. Using this solution it is possible to achieve following travel times between Prague and Brno:

a) standard-car-train, maximum speed at reconstruction corridor line (RCL) section – 160 kph, at new-construction HSL – 200 kph and at near Brno section (B) – 120 kph 1 hour 51 minutes,
b) standard-car-train, maximum speed at RCL after adaptation of control system – 200 kph, at HSL – 200 kph and at section B – 120 kph 1 hour 33 minutes,
c) train-unit, maximum speed at RCL after adaptation of control system – 200 kph, at HSL – 300 kph and at section B – 120 kph 1 hour 22 minutes.

For example in the time table 2006/2007 the travel time between Prague and Brno for train no. SC 135 Pendolino is 2 hours 23 minutes, what is about 61 minutes more than in case c), train no. EC 175 standard-car-train 2 hours 40 minutes, it is almost twice as more than in case c).
3. **Simplified description of proposed route of HSL**

The choice of route was modified many times, by reason of geologic conditions, ecological point of view and many collision points with pipelines, power grid and telecommunication system [6]. Last but not least the route was modified by reason of minimization of horizontal curves and vertical articulation.

The route starts by excursion from RKT near railway stop Sedlíst'ka in altitude 250 m between railway-stations Zámrsk and Choceň and leads to south-southeast towards vertex point in altitude 559 m in track km 37,4. Further the route slowly sinks with up-hills to the end of HSL. That end is near railway stop Česká, where HSL empty into existing route between railway stations Kuřím and Brno-Královo Pole in altitude 395 m. The HSL can be leaded into junction Brno other way. For sketched solution were calculated running times and energetic calculation. That route has 9 horizontal curves with radius from 7000 to 8000 meters, in total length 29,7 km. Middle inclination on north ramp is 8,26‰ and on south ramp 4,88‰. Maximum inclination of route is 23‰, in length 2,5km on north ramp.

Nearly 26 % of new work is artificial constructions. There are 11 large bridge objects in total length 6,13km (the longest one has 1388m), 13 tunnels in total length 17,75km (the longest one has 3323m [5].

The question of explicit static axle pressure will be answered after evaluation of requirements and economic balance. That process is a part of development. Is high likely that on HSL will be, from economic reasons, operated beside light units for 300 km/h also fast liners for 120 km/h in saddles.

4. **Transport flows, transport demand**

In transportation investigation, made in frame of [7] and in other investigation were stated average volumes of passengers for year 2006. They are shown in next table.

<table>
<thead>
<tr>
<th>Mean of transport</th>
<th>Average volume of passengers/day In year 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAT</td>
<td>15 708</td>
</tr>
<tr>
<td>Buses</td>
<td>3 345</td>
</tr>
<tr>
<td>Railway</td>
<td>3 997</td>
</tr>
<tr>
<td>Total</td>
<td>23 050</td>
</tr>
</tbody>
</table>

The investigation subject of perspective transport demand was target only on passenger traffic in relation Prague – Brno in both directions. By two independent processes was derived for horizon year 2015 zone from 6 to 8 thousand of passengers/day without charge of transit passengers, that is app. 2,1 – 2,8 mil of passengers/year [7]. That will call for 1 train/hour in rush period and 0,5train/hour in saddle. Expressive increase of transport demand was proved in Germany [3], France [8] and Spain [9]. The permission of demand increasing gives also capacitive overloaded highway between Prague and Brno with congestions, accidents and supposed implementation of toll for private cars from year 2012. Another transport demand is in precedence package, mainly in international relations.
5. Sketch of costs

Related running costs will be, under conditions accepted in previous part 4, covered from more than 90% from incomes from travel costs. If there will be included also transit passengers, the volume of passengers will increase for app. 40%. That is app 3.5 mil. passengers per year. That volume is similar to volumes of passengers in foreign HSL whereat costs are covered from incomes. Capital expenditure for build-up of HSL are app. 500 mio CZK/km. All those costs must be taken as directory and no-obligation information, which means not documented and unverified. That will be subject of future activity of common solving team from both Universities.

6. Conclusion

Time runs fast – need of HSL is in Czech Republic still actual. The proposal of alternative high speed railway connection between Prague and Brno vest in possibility of synergy combination of speedy corridor route from Prague to Sedlíšťka (Chocen – Česká Třebová) and consequential HSL Sedlíšťka – Česká ( – Brno). That way needs also lower costs of investment of course. It’s time to resolve upon new alternative of connection between Prague and Brno.

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Literature:


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