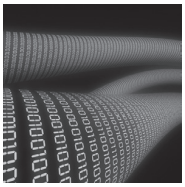

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Influence of changing station layout over railway interlocking

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ABSTRACT
The aim of the article is to present the influence of changing station layout over interlocking systems in train routes. There is often a problem in the process of doing for example application of interlocking system in exactly bigger stations when there are track changes in next phases of the project. Vividly small changes can influence in significant way for realization train and manoeuvre routes in such station. In case of that it is necessary to search the shortest road of making documentation and software which could be changes resistant. This resistance resulted by for example necessity of continuing leading railway when there is modernization on the station.

KEYWORDS: interlocking table, schematic plan, rail control solution

1. Introduction

Author in the next chapters gives more clearly and specific examples of changing station layout. In the last chapter there is solution how the problem could be done.

In the first there must be some information to prepare reader in the topic of article. For the person who creates interlocking table fundamentally is to know what is schematic plan.

The schematic plan – is created on the basic of layout plan of railway track system. There is presented layout of railway tracks and crossings in contaminated scale (longitudinal 1:2000, transversal 1:500) and there are marked railway control devices and routes of trains. It is allowed to apply different scale [1].

It is necessary to mark in the schematic plan[1]:

a. numbers of tracks, points and derailers;
b. ends of points, main position of points and derailers and location of switch-drives, switch-locks and local adjusters towards tracks and switches;
c. semapfores and indicators with theirs localization;
d. train routes with indication of way and types of trains;
e. adjusting rail station with specific type of devices and dispatcher situated;
f. rail station district bounds;
g. levelcrossings and crossing, bridges, overpass and other devices and buildings having influence on signals situated and visibility
h. platforms and theirs active edges, flip-flaps;
i. lines way which are join into the station with pointed names of next station;
j. electricity tracks;
k. number of kilometers covered building of the railway, levelcrossing, adjusting rail station etc.;
l. track circuit control systems;
m. interplay devices;
n. track lead train control systems;
o. levelcrossing systems;
p. north side.

The interlocking tables are designed for controls clear performance, which is included on train and manoeuvre routes. They are created on basics of railway station's schematic plan and they are part of project's documentation. Tables are designed, especially in situations, when dispatchers need to decide by themselves about letting train go e.g. on replace signal.

The interlocking table consists of upper part, with heading of table and lower part, with closing table. The heading of interlocking table states type and quantity of internal, adjustable and block controls. On the other hand, closing table indicates point locks and mutual interactions between controls [1].

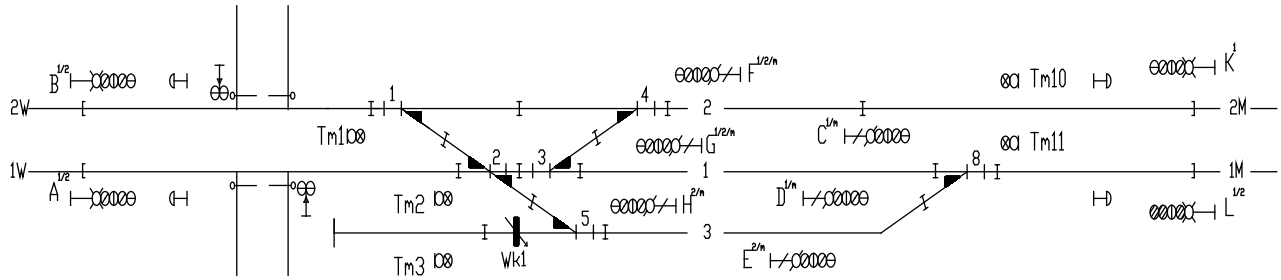


Fig 1. Example of simplified scheme of fictitious railway station

Table 1 . Table of closing devices

	Closing devices							*Isolated sections*	
Routes	*1*	*2ab*	*2cd*	*3/4*	*5*	*8*	*Wk1*	*Points*	*Tracks*
A^1	$+_o$	+	+	+	$+_o$			*Jz2, Jz3*	*Jt1, JtA*
A_2^2	$+_o$	+	+	-	$+_o$			*Jz2, Jz3, Jz4*	*Jt2, JtA*
A_3^2	$+_o$	+	-		-		$+_o$	*Jz2, Jz5*	*Jt3, JtA*
B^1	+	$+_o$		+				*Jz1, Jz4*	*Jt2, JtB*
B_1^2	-	-	+	+	$+_o$			*Jz1, Jz2, Jz3*	*Jt1, JtB*
C^1									*JtK*
D^1						+		*Jz8*	*JtL*
E_1^2						-		*Jz8*	*JtL*
F^1	+	$+_o$		+				*Jz1, Jz4*	*JtB*
F_1^2	$+_o$	+	+	-	$+_o$			*Jz2, Jz3, Jz4*	*JtA*
G^1	$+_o$	+	+	+	$+_o$			*Jz2, Jz3*	*JtA*
G_2^2	-	-	+	+	$+_o$			*Jz1, Jz2, Jz3*	*JtB*
H_1^2	$+_o$	+	-		-		$+_o$	*Jz2, Jz5*	*JtA*
H_2^2	-	-	-		-		$+_o$	*Jz1, Jz2, Jz5*	*JtB*
K^1									*JtK, Jt2*
L^1						+		*Jz8*	*JtL, Jt1*
L_3^2						-		*Jz8*	*JtL, Jt3*

For better understanding signs in the table 2 it is necessary to write concepts (what does it mean). There are two most important concepts, exactly main position and rearranged position of points.

There are signs for the first part of interlocking tables: closing devices. We distinguish these kind of signs and meanings:

a. + main position of point and derailer (moved and closed)
b. - rearranged position of point and derailer (moved and closed)
c. $+_o$ main position of point and derailer which is in safety road (moved and closed)
d. $-_o$ rearranged position of point and derailer which is in safety road (moved and closed)
e. main position of point and derailer which is in safety road (moved and non-closed)
f. rearranged position of point and derailer which is in safety road (moved and non-closed).

There are signs for the second part of interlocking tables: contradiction table. We distinguish these kind of signs and meanings:

a. + excluded routes through another position of devices (points and derailers)
b. special excluded routes
c. - same routes.

2. Examples of changing layout station

The second part of the article introduce reader to description changes layout station with theirs influence over interlocking in train and manoeuvre routes. All points (examples) have got figure and description.

a. changing of main position of point (derailer)

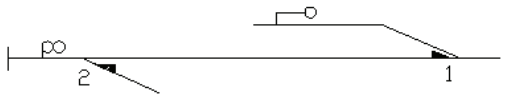


Fig 2. Position of point 2 in plus straight

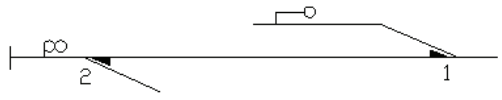


Fig 3. Position of point 2 in plus on side

Figure 2 shows initial project situation, where main position of point 2 is in plus straight. Designer can change main position of point if there could be easier to read for dispatcher interlocking tables. In the above example the key is point 2 which was changed to main position in plus on side. It is necessary to remember that the most important routes are these through point 1 in position plus. Additionally for these routes point 2 is on side protection. That is why designer decided to change point's 2 position for plus on side which is clearly to understand for workers on station who use interlocking tables.

b. adding rib with extra point or derailer

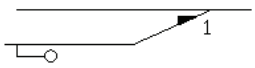


Fig 4. Point 1 in the first phase of project

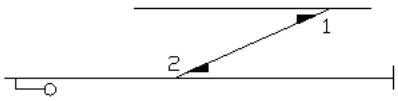


Fig 5. Track with extra point 2 and rib

In the example which is showed in figure 4 and figure 5 becomes to additional new point and peace of track with flip-flap. The aim was to use extra safe for train routes which are through the point 1 in plus position. For such routes it becomes to close point 2 in position plus on side protection. In the figure 4 there is semaphore A which ensure safety but it is dangerous. This danger follows that locomotive driver can go by the semaphore thought that it shows permitted signal but exactly it shows not permitted signal (red). This solution often appears in the next stages of project which insert significant changes into the first part of tables: exactly closing tables. There will be new column with point which position will be signed for train routes (in road or safety) and for maneouvre routes (in road). It is not the only one example with new point in project but author wants to show exactly this.

c. new built-in tracks derailer for on side protection

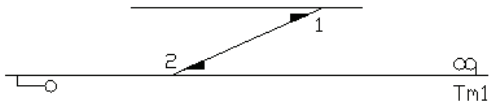


Fig 6. Track layout without derailer

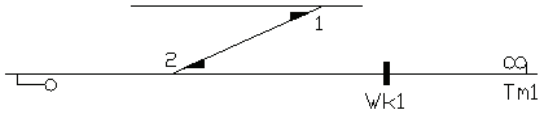


Fig 7. Track layout with safe derailer

The example which is pictured in figure 6 and figure 7 becomes to additional new derailer built-in track layout. This new object has to protect train routes (if it is necessary manoeuvre routes) which are through point 1 and 2 in minus position. There are possible to go from Tm1 with manoeuvre route additional. This is a danger situation which can lead to rail accident. There is everything possible when only semaphore is on side protection. It is similar example then previous but the track change is completely different. The reason of change is to use extra safe for train routes through the point 1 and point 2 in minus position. Then derailer Wk1 is closed in plus position that is install on track. This change does not influence to contradiction's table but has got main influence for closing table. There will be new column with derailer and of course signs:

- plus for routes through the point 1 and the point 2
- minus for routes through Wk1.

d. moving on side safety

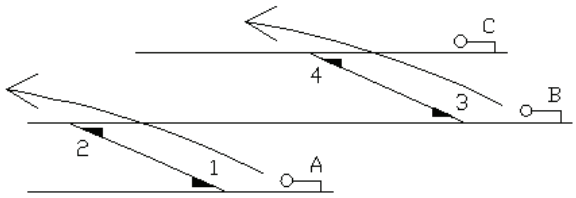


Fig 8. Parallel routes from semaphores A and B.

Figure 8 illustrates making of two parallel train routes from semaphore A and semaphore B through properly points 1 and 2 in minus, points 3 and 4 in minus too. For the route from A there is point 3 on side safety so there are no problem to turn on the permitted signal. But there could be a problem when dispatcher wants to make straight route from semaphore C. Then there have to be non-closed point 3 for the first route. It is the best solution and this kind of situation is showed in the figure 9.

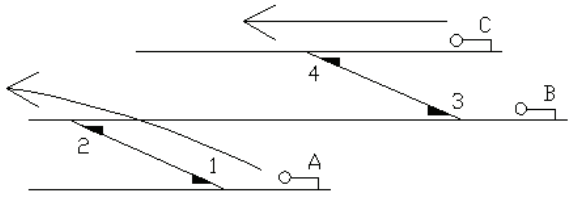


Fig 9. The second route from semaphore C.

Thanks to non-closing point 3 with restraint route from signal A there can be make train route from signal C which move point 3 to position plus and close it. For this example there are two overlaps from semaphore A which are different by on side safety (exactly point 3 properly for main route in position minus and for the second route in position plus). There is important to remember that in the contradiction's table there will be excluded for main route from A with every routes from C. This example has got a big influence into the interlocking table and it is necessary to check exactly if there are these kind of changes.

e. safety road behind the semaphore

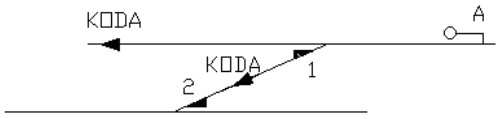


Fig 10. Safety Road behind the semaphore with point 1

Figure 10 illustrates situation when safety road behind semaphore comprises point 1which is the next object in track layout. This problem follows that restriction of semaphore location or short braking distance. There is need to be two variants of safety road. The first, main route is with point 1 in plus position (of course non-closing, if there are not routes without stop on the station it is the last one) and the second with point 1 in minus position (if there are routes without stop on the station next start from the semaphore A).

The next situation which is illustrated on figure 11 is moving safety road behind the semaphore with two points.

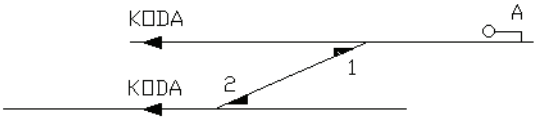


Fig 11. Safety Road behind the semaphore with points 1 and 2

For the above example there are following points positions (variants of safety road):

- Z 1+ 2+
- w_1 1+ 2-
- w_2 1- 2-

There are two new routes in interlocking table and there are extra exclusions, especially for routes to semaphore A and parallel routes through point 2 in position plus.

f. routes without stop

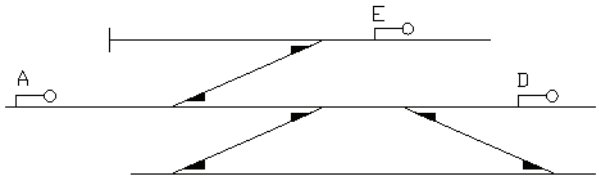


Fig 12. Example station layout

There is possible to turn off router without stop through the station and then adopt that semaphore A is a home signal and semaphores D, E are exit signals, next routes from these signals

will be excluded. It is necessary to write it in contradiction table. This example is illustrated on figure 12. Engineer who is creating project can make this decision when for example on the station there is connection lines with a big meaning and small lines which are not important for rail movement. Sometimes it could be designer decision at rail staff request. This case has got a big influence for contradiction table because all routes which can be continuing has to be excluded (train route→train route). Of course designer decides which exactly routes are not without stop. It is necessary to make exclusion of routes (instruction WTBE10): properly train route→ manoeuvre route.

g. special excluded routes

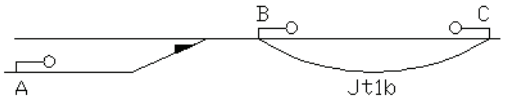


Fig 13. Routes to semaphores B and C exclusions

Routes to semaphores B and C are not excluded because of different position of devices but when there is only one track circuit between them it is necessary to exclude these routes in contradiction table. These are special excludes. Making these routes at the same time can block track and movement on the station. So there must be extra locomotive to move train, unblock the track and there occupy a lot of time and money. Of course there are safety aspects in this kind of problem.

3. Propositions of difference overcoming resulted by station layout changes

Examples which are specified in the second chapter figure problems connected with changing station layout during phasing modernization project of rail station. All problems are different then each other. There are examples which could be on specific situations on stations and it depends of movement situation. Despite of they are different all of them have influence over interlocking tables. It is necessary to know that this document is like a bible for dispatcher work and gives him essential and incorrect information about specific station. It is needed when there are problems with devices or for example with superior system. Then dispatcher can be certain when he will be change points positions and switch on call-on signal. At the moment when there was a big accident in Szczekociny it is very important to be certain that everything is perfect and safety.

Author has got the proposition to make interlocking tables despite of phasing processes problems. It will be a special tool for designer to change tables without complications and hardworking. There is no fundamental in what format it is saved:

- interlocking tables (closing and contradiction),
- routes book.

It is important not to make it by hands (it means slow writing all new closes and exclusions) but it has to be generated automatically. this generator can do the same things faster and cheaper than designer. These tables of course could be incorrect than these make by hands. Man can make a mistake everywhere and it is not depend on phase changes. Program is write with a designer logic and generating mistakes could be more clearly to find. This tool (generator) has to base by the station layout so it is geography based program. There have to be following objects unconditional:

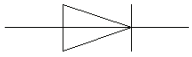
- point symbol

- derailer symbol

- semaphore symbol

- manoeuvre semaphore symbol

- end of route symbol



- safety road behind semaphore symbol

Optionally there could be appear objects:

- track circuit symbol

- levelcrossing symbol

- line block symbol

Optionally symbols are used as extra information written in closing tables. Thanks to this additional objects it is known:

- route is incoming or outgoing,
- there is levelcrossing addicted,
- which track circuits are in safety road,
- what kind of line blocks are in concrete way.

It is a fundamental knowledge which has got dispatcher who wants to control station. All of dispatchers have to study interlocking tables and schematic plan before starting working on station. Superior system is created by means of schematic plan and movement documentation. Of course interlocking table is created and needed by interlocking system on the station.

Introducing computer systems on railcontrolling gave a lot of new useful news and possibilities. But there sometimes are too many ways to create something and designers ideas are so exaggerated. Then sometimes programmers fall into a trap. There are used by designers present station layout which was made for other control devices. There are a lot tracks and route overlaps. For computer devices it gives possibility to create various train routes and sometimes there are too many. There is a bigger risk too. But there are one big advantage: more variants bigger capacity.

4. Conclusion

With respect to polish railway situation and modernization phases generator (tool) should take changes in station layout into account. Every changes should not influence interlocking tables.

Designer has to draw the station with all needed objects in concrete line like there are on schematic plan. There is important to give suitable names like it is in instructions of the tool and schematic plan. When there is all station on a draw then it will be read into the generator to make interlocking tables.

The sense of making this program is to reduce human work with interlocking tables which are the most important document for dispatchers.

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