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Analysis of Instrument Approaches to GA Aerodromes in the World

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Abstract- **This article deals with the exploration of GA aerodromes around the world that meet the defined input conditions of maximal 1,500 m long runway and the existence of straight-in instrument approach. These aerodromes are analysed from different perspectives of runway equipment with respect to the various types of published approach.**

Keyword – General Aviation, Aerodrome, Straight-in Approach, non-precision approach, runway lighting

I. Introduction

General aviation (GA) is in the number of aircraft the largest in the entire aviation, but it is ranked as the third in the last place after the military and civil aviation. At present, however, the pressure from representatives of general aviation intensifies, and it is needed to count with it when changes are made in the airspace.

Battles between the groups are to be found even inside GA. They are caused by the collisions between the views and demands of flying under IFR and VFR, which may seem absurd given the completely different weather conditions for flights, but to ensure the safety of IFR flights is necessary to allocate a portion of airspace, which in turn can act as a barrier for VFR flights.

The expansion of GA in Europe is inevitable as is the rising demands to create new instrument procedures at non-instrument aerodromes. But for this aerodromes is for the creation, implementation and approval of such procedures quite costly, mostly in terms of aerodrome infrastructure, which is necessary to have or to be built at the aerodrome. Thus was created the list of aerodromes and its infrastructure compared to the used instrument approach system.

II. Selection of Aerodromes

Due to the requirements for the introduction of instrument approaches to the still non-instrument GA aerodrome in this analysis was set a limit of 1500 meters for runway length, which defines "small" aerodrome. It was also necessary to choose only aerodromes with published straight-in approach, which is what you want for IFR operations and enables significantly lower minimum descent height, respectively decision height. The choice the aerodromes have been used states with well-developed GA, such as Australia, New Zealand and Canada and all States under the supervision of EUROCONTROL.

III. Results

The number of approaches for subsequent analysis is 768 This number could be higher, but the runways that have approach which used the same system on both ends of the runway and have same light equipment are considered only from runway end with lower OCH.

A. Physical characteristics of the runways

For comparison of the different runways were chosen three parameters namely length, width and surface.

At present, it is almost unthinkable that in the Europe could be instrument approach to runway with another surface than concrete or asphalt. The exception in the analysed aerodromes forms one aerodrome in Greenland (outside Europe, but in the scope of EUROCONTROL), one in Ukraine and two in the United Kingdom. However, in the remaining three analysed countries is quite common that the runway surface is gravel, grass or dirt.

Table I. Runways Length

Runway Length	Number	Percent
up to 300m	1	0,13
301-600m	1	0,13
601-900m	53	6,90
901-1200m	327	42,58
1201-1500m	386	50,26

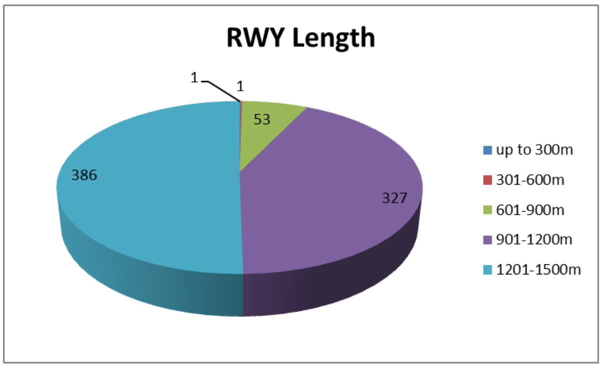

Figure 1. Runway Length

TABLE II. RUNWAY WIDTH

Runway Width	Number	Percent
up to 10m	2	0,26
11-20m	43	5,60
21-30m	619	80,60
over 30m	104	13,54

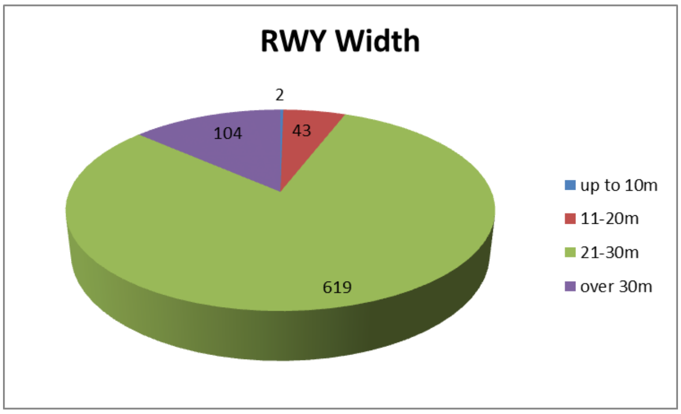

Figure 2. Runway Width

TABLE III. RUNWAY SURFACE

Runway Surface	Number	Percent
Dirt	3	0,39
Crushed rock	8	1,04
Sand	2	0,26
Gravel	104	13,54
Grass	7	0,91
Asphalt/Concrete	644	83,85

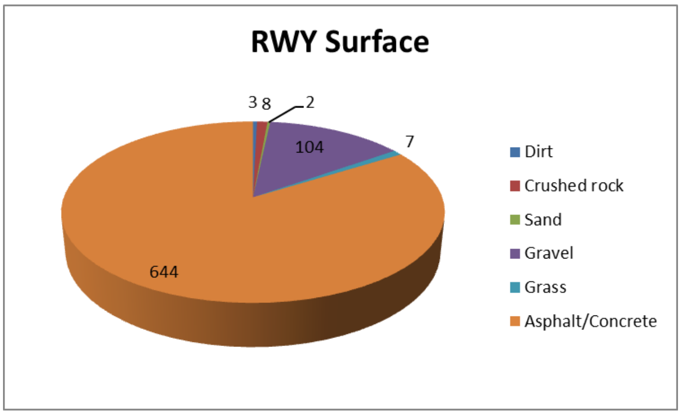

Figure 3. Runway Surface

Comparison of physical parameters of runways has been added here only for information purposes, since the size of the RWY only affects the category of operated aircraft. But from these comparisons could be concluded needed equipment of aircraft "categories" for IFR flying.

B. Runway lights

Given that aviation regulations allow IFR traffic on runways without lighting systems, it is interesting to see how this option is used by individual aerodromes. But it is necessary to realize that the minimum RVR at which it is still possible to land increases along with reducing runway lights, which also reduces the possibility of sighting the runway (or light navigation aids) at the minimum descent altitude, respectively decision height. This limits the use of instrument approach.

Runway lights have the vast majority of analysed aerodromes, but approach slope/path lights has only two thirds of aerodromes and approach lighting system has only 40% of the runways.

TABLE IV. RUNWAY LIGHTS

Runway Lights	Number	Percent
yes	749	97,53
no	19	2,47

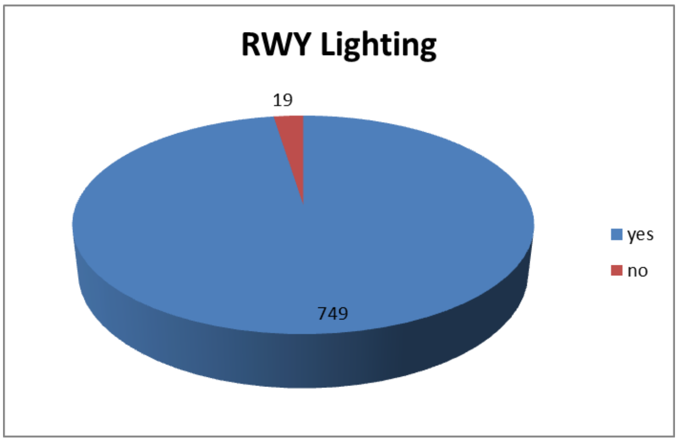

Figure 4. Runway Lights (minimum is RWY edge lights)

TABLE V. APPROACH SLOPE/PATH LIGHTS

Approach Slope/Path Lights	Number	Percent
nothing	257	33,46
AVASIS	10	1,30
AT-VASIS	1	0,13
T-VASIS	2	0,26
VASIS	23	2,99
APAPI	101	13,15
PAPI	310	40,36
PLASI	63	8,20
unknown	1	0,13

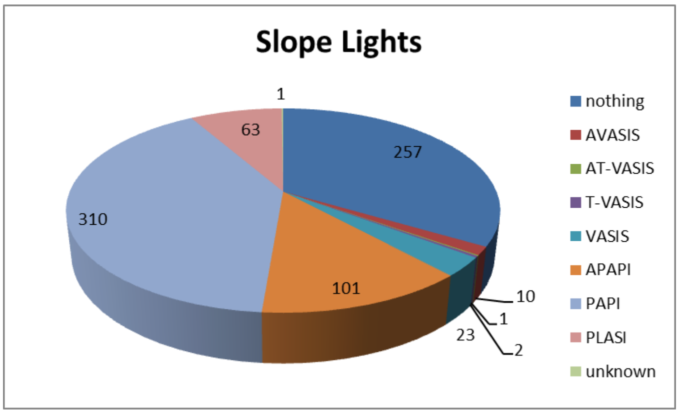

Figure 5. Approach Slope/Path Lights

TABLE VI. APPROACH LIGHTING

Approach Lighting	Number	Percent
nothing	305	39,71
RWY ident	153	19,92
ODALS	40	5,21
MALSR	2	0,26
CL	10	1,30
SALS	90	11,72
SALS + ident	23	2,99
CL + RWY ident	21	2,73
Lead-in	14	1,82
Cat I	28	3,65
MALSF	1	0,13
yes	5	0,65
CL/XBAR	75	9,77
unknown	1	0,13

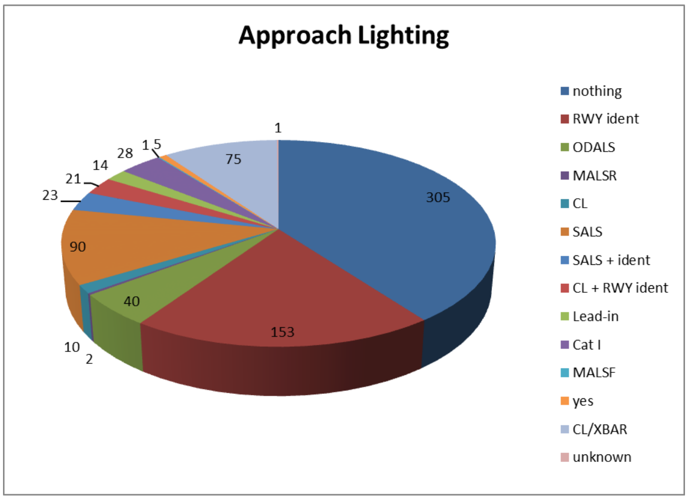

Figure 6. Approach Lighting System

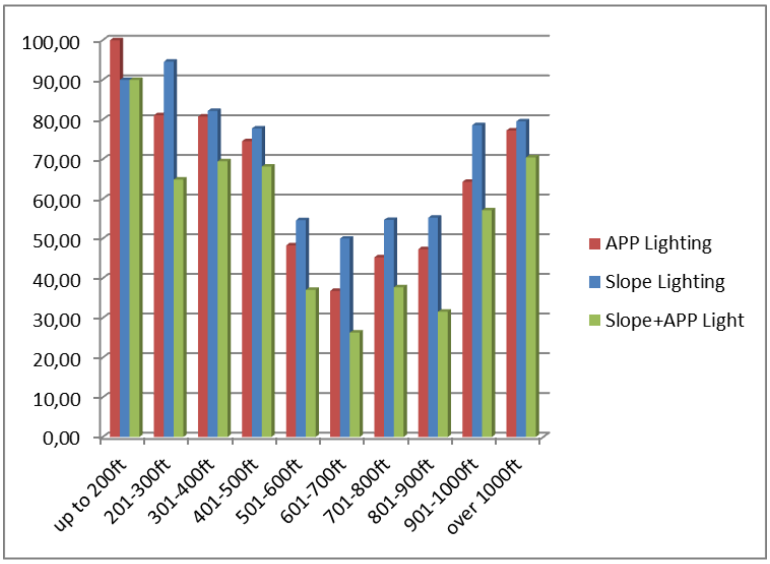

Figure 7. Percentage of Lighting Systems in Comparison to RWY OCH

C. *The Presence of ATS*

Current situation in the Czech Republic shows a reduction in requirements for aerodromes with IFR procedure. The main one is the abolition of the requirement to have at this aerodrome ATC and around the aerodrome controlled airspace. The following table therefore shows the number and percentage of different types of airport services.

TABLE VII. THE PRESENCE OF ATS

ATS Type	Number	Percent
AFIS	222	28,91
APRT RDO	53	6,90
Unicom	103	13,41
TFC	95	12,37
Radio	52	6,77
nothing	110	14,32
TWR	133	17,32

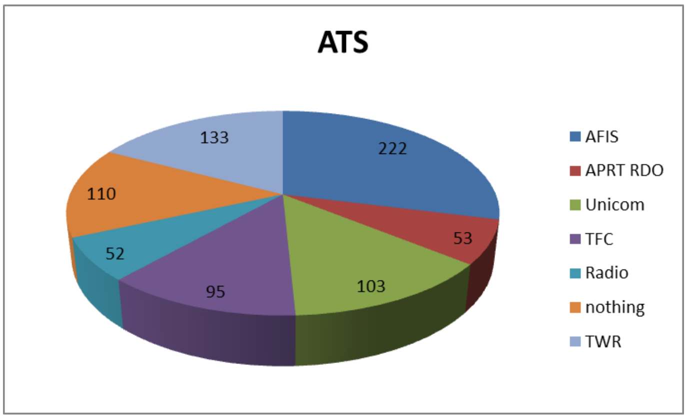

Figure 8. The Presence of ATS

D. Approach systems

The type of approach system determines the approach minima for the runway. In recent years, the effort is to move from ground-based to space-based navigation systems and therefore to some type of GNSS.

TABLE VIII. THE USAGE OF APPROACH SYSTEMS

Approach System	Number	Percent
VOR	21	2,7
DVOR	1	0,1
VOR/DME	29	3,8
GNSS	72	9,4
IGS	2	0,3
ILS	19	2,5
ILS/DME	6	0,8
GPS	2	0,3
LNAV	233	30,3
LNAV/VNAV	17	2,2
LPV	21	2,7
LOC	37	4,8
LOC/DME	23	3,0
LOC(BC)/DME	3	0,4
LOC/NDB	1	0,1
2NDB	3	0,4
NDB	190	24,7
NDB/DME	37	4,8
NDB/VOR	3	0,4
RNAV	18	2,3
SCAT-I	20	2,6
SRA RTR	5	0,7
SRE	2	0,3
TACAN	2	0,3
VDF	1	0,1

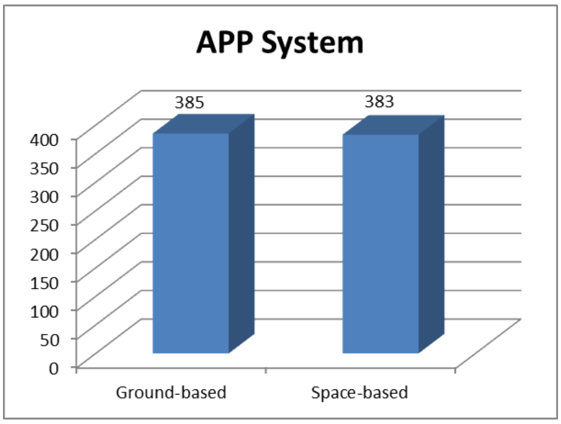

Figure 10. Ground-based vs. Space-based approach systems

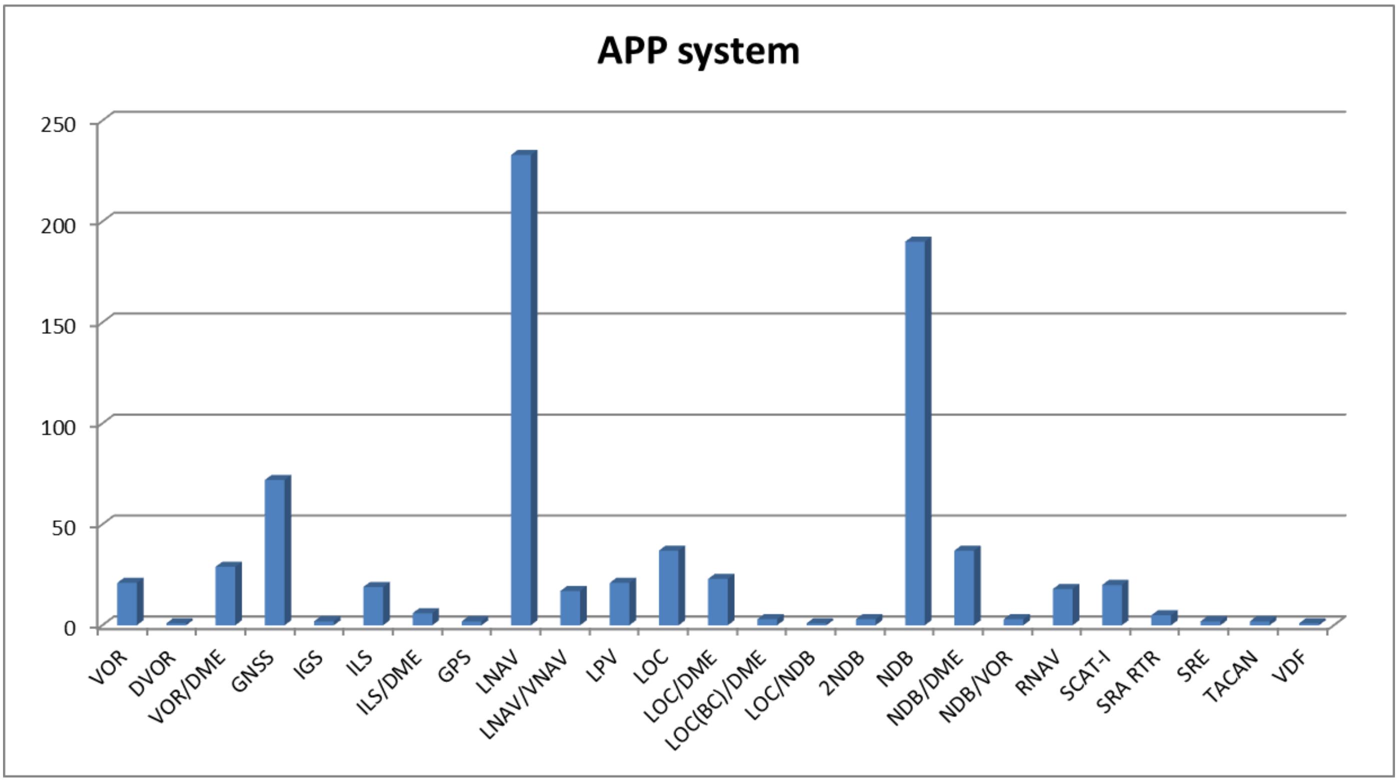

Figure 9. Approach systems at analysed aerodromes

E. Approach systems and RWY lighting by the analysed states

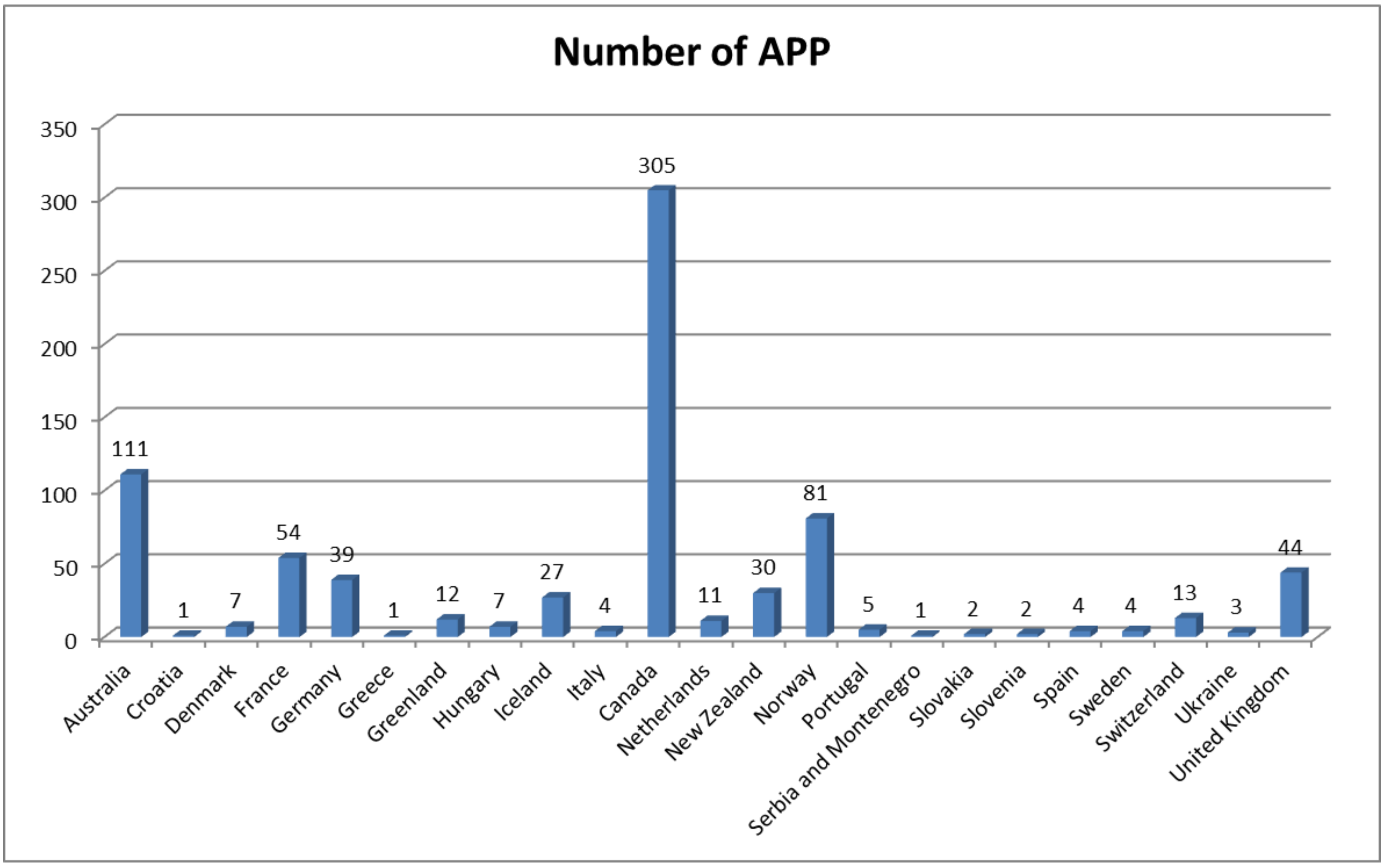

Figure 11. Approach systems by states

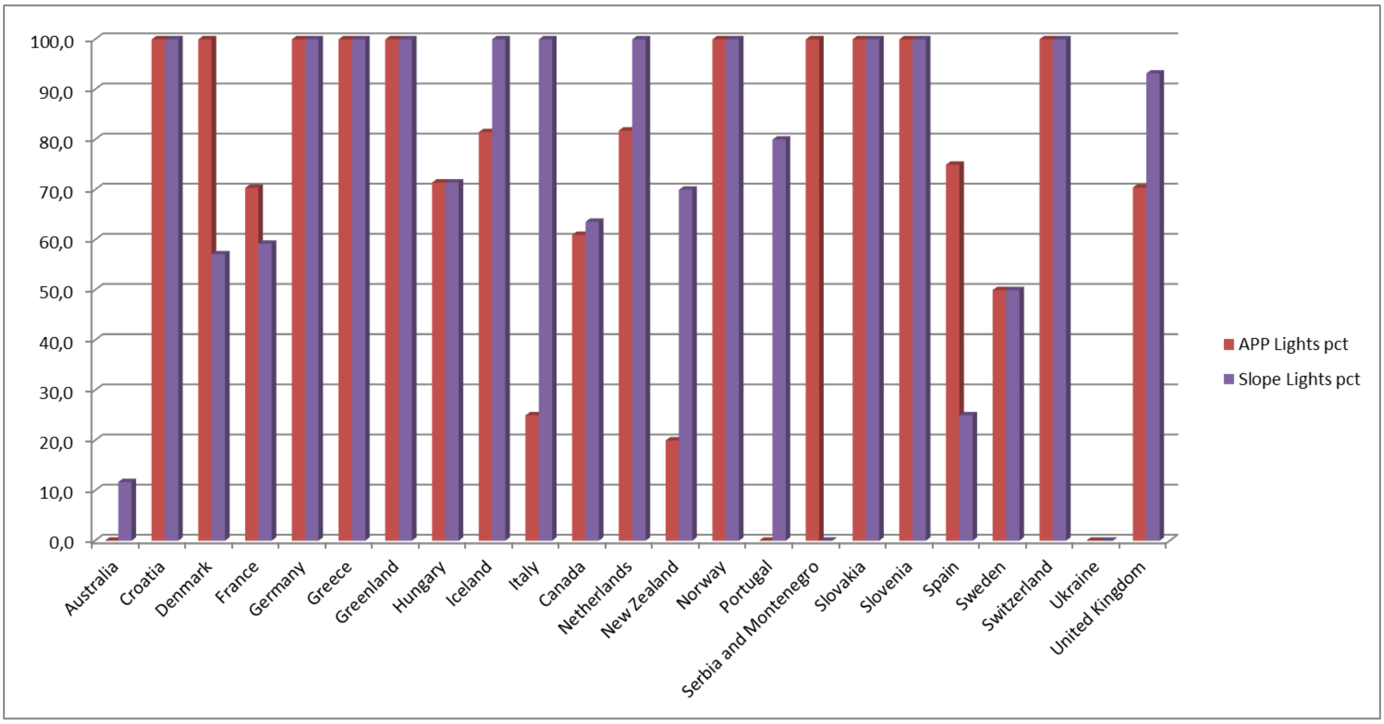

Figure 12. Percentage of approach lighting system and approach slope/path lighting system on the runways of analysed aerodromes by states

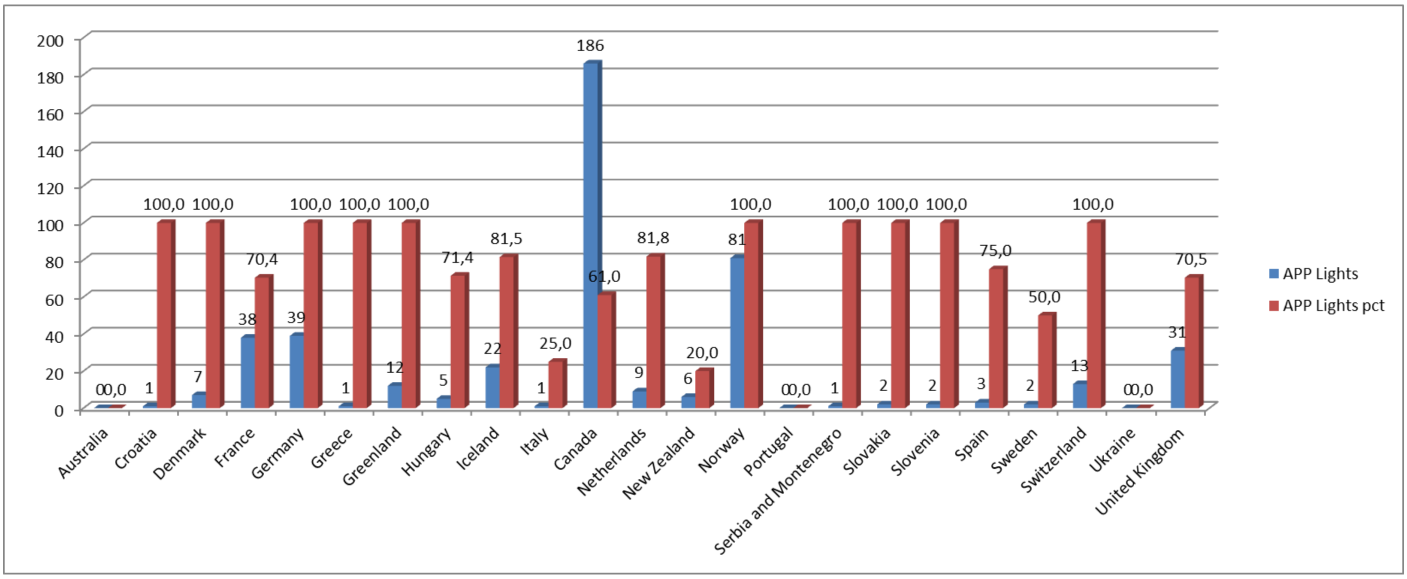

Figure 13. Absolute and relative numers of approach lighting system on the runways of analysed aerodromes by states

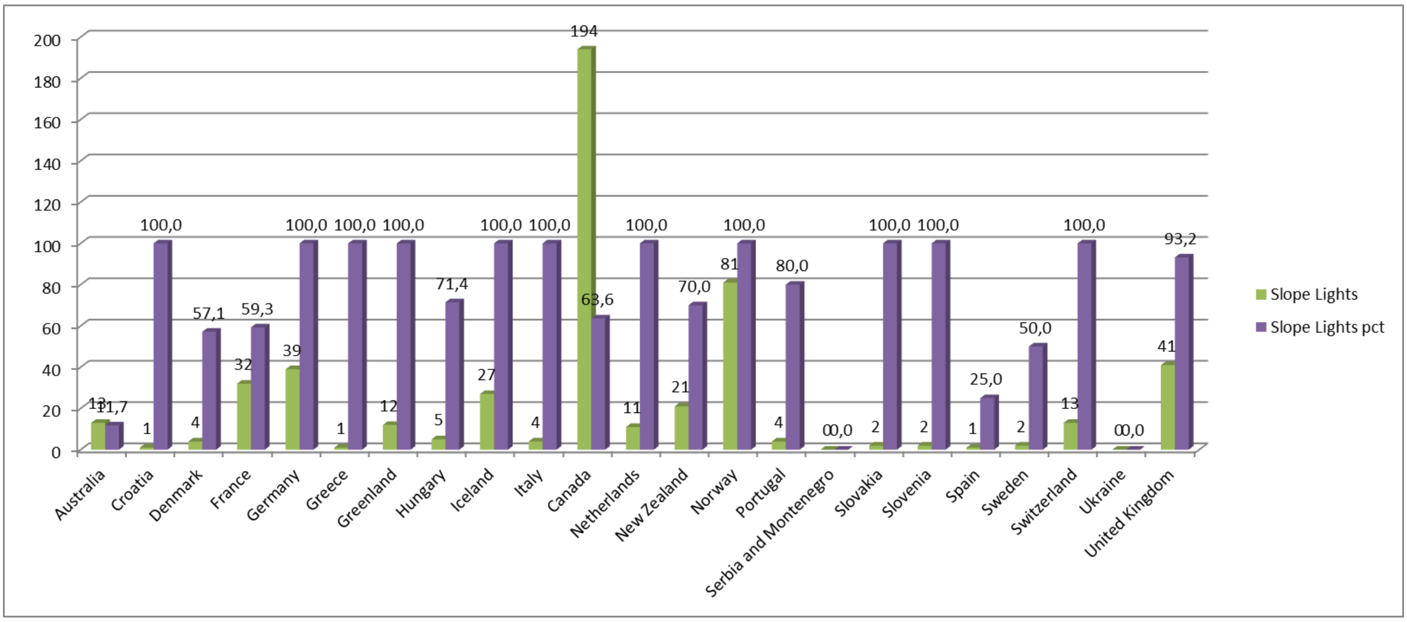

Figure 14. Absolute and percentage numbers of approach slope/path lighting system on the runways of analysed aerodromes by states

IV. CONCLUSION

The aerodromes analysis shows that the introduction of a new instrument approach to the aerodrome is possible from the regulation point of view. Instrument approaches in the world are used on aerodromes, which are from a European, respectively Czech perspective completely incapable.

This situation exists certainly due to the different geographical structure of states and therefore highly developed small aviation. To that is also related the perception of safety and respect for the regulation (compliance with regulations), the so-called safety culture. Thanks to its development is probably possible to find specialties in the Aeronautical Information Publication such as a railway across the runway at the aerodrome in Gisborne, New Zealand. (See Fig. 15)

From the perspective of regulations and practice it is possible to introduce instrument approach to any aerodrome in the world. It depends only on the approach of the supervisory authorities; if they are willing to give responsibility to aircraft pilots, or whether they want to have a properly treated all possible cases that may happen. The first approach is useful for airspace users, but in the event of an incident, or worse, an accident can be blamed the authority as indirect cause. In the second case should not happen any dangerous situation, since they are all protected by regulations, but they are also a limiting factor that may be violated. In this case are authorities are out of guilt when some situation with impact on safety take place.

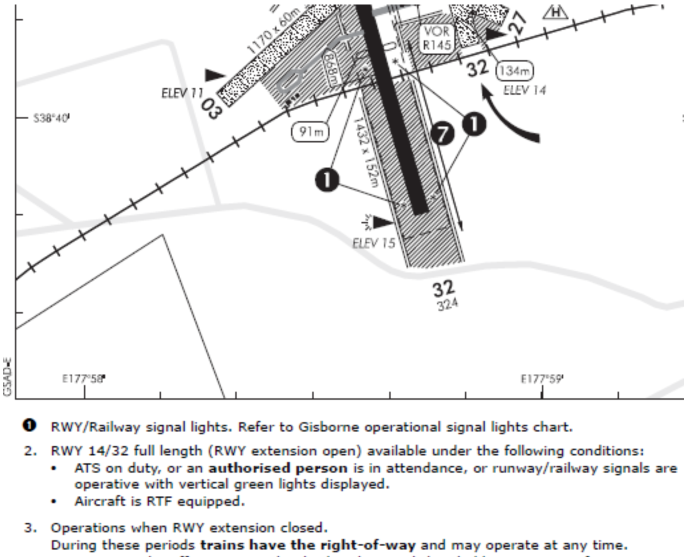

Figure 15. The map section of the AIP New Zealand - railway across the runway

II. ACKNOWLEDGEMENTS

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