What is the impact of additional runway to obstacle limitation surface area?

Ari Sandhyavitri* and Fatimah Insani Harahap
Faculty Engineering, University of Riau, Bina Widya Campus, Pekanbaru, 28293

*Email: ari.sandyavitri@lecturer.unri.ac.id

Abstract. It is obvious that the additional runways (one or two more runways) from the existing runway at a specific airport may increase the overall obstacle limitation surface areas within the airport. In fact, based on a case study at Kualanamu International Airport, Indonesia, it was revealed that an increase the number of the runway from 1 runway to become 2 runways were not necessary to increase the overall obstacle limitation surface areas. It was identified that the vertical height of the existing obstacle limitation surface decreased at the range of 1.961% to 8.163%, however, the horizontal one increased at 8.57%.

1. Introduction
The Kualanamu International Airport is located in Deli Serdang regency, Indonesia about 39 km from the center of Kota Medan. In 2019, it was appointed as the third largest airport in Indonesia with a single runway. This runway may accommodate wide-body aircraft such as Boeing 747. Based on the Kualanamu’s Masterplan listed in KP 482 [1], there will construct a new addition of the runway from the existing 1 runway to become 2 runways, as there was a demand of additional runway for this airport as calculated using KM 57 2007 standard [2].

Based on the Directorate General of Air Traffic Transportation Decree Number SKEP 48/III [3], it was stated that an airport should be clear from a number of obstructions including buildings, towers, hills, trees and other obstructions. These clear areas were known as an obstacle of limitation surface. This area is surrounded areas within the airport which are required for accommodating safe flight operations. These areas were divided into 6 zones, encompassing: Conical surface area, inner horizontal surface, approach surface and inner approach surface, transitional surface, and balked landing surface area. The purpose of this research was to determine the shift of vertical and horizontal of the existing Obstacle Limitation Surface areas based in 2018 based on KM 57 2007 and ultimate condition in 2030 based on KP 482 2018. This article also developed a map of Obstacle Limitation Surface in Deli Serdang regency by using a digitation method.

2. Method
In this study, Kualanamu International Airport used Instrument Precision which was a navigation aid for runways equipped with instrument landing system and visual landing aids, category I, code number 4F, Annex, 14 [4].

2.1. Percentage of high change and area change
The result of area change of obstacle limitation surface is formed in percentage was calculated by
where $RU$ is the area of obstacle limitation surface in ultimate condition, $RE$ is the area of obstacle limitation surface in the existing condition.

For the high change is formed in percentage was calculated by

$$\frac{(RU-RE)}{RE} \times 100\% \quad (1)$$

where $TU$ was the elevation of obstacle limitation surface in ultimate condition, $TE$ was the elevation of obstacle limitation surface in the existing condition.

### 2.2. Steps to do digitation

To discover the area of Obstacle Limitation Surface which included in Deli Serdang by using digitation method with a Deli Serdang administration map and obstacle limitation surface map for Kulanamu International Airport, Indonesia.

![Digitation steps](image)

**Figure 1.** Digitation steps.

### 3. Results and discussions

The results will be discussed in 3 subsections, they are a percentage of high change and area change from an existing condition to ultimate condition, the region of obstacle limitation surface in existing condition and ultimate condition, and area obstacle limitation which included Deli Serdang.

#### 3.1. Percentage of obstacle limitation surface

**3.1.1. The high change deviation of obstacle limitation**

The vertical high deviation of obstacle limitation surface from the existing condition in 2018 to the ultimate condition 2030 is shown in Table 3. Based on the table, the deviation is caused by the additional runway in Kualanamu International Airport at the range of 1.961% to 8.163%. Hence, it was not necessarily an increase in a number of the runway(s) an airport may increase the vertical height of its obstacle limitation surface areas.

**3.1.2. The deviation of horizontal area change**

The Existing obstacle limitation surface condition 2018 = 810,930,892 m²
The estimated ultimate area condition 2030 = 880,409,978 m²
Percentage of Area Obstacle Limitation Surface = $\frac{880,409,978 - 810,930,892}{810,930,892} \times 100\%$

= 8.57 %

An increase in the percentage of the obstacle limitation surface area from the existing 2018 condition to the ultimate 2030 condition is estimated as 8.57%.
Table 1. Percentage of deviation high change.

| Area                              | Existing Condition | Ultimate Condition | %  |
|-----------------------------------|--------------------|--------------------|----|
|                                   | Radius (M)         | Radius (M)        | AES |
| Approach Surface and Inner Approach Surface | Start 49         | Start 45         | -8.163 |
|                                   | End 151           | End 145          | -3.974 |
| Approach Surface Inner Approach   | 3,000 49          | 3,000 45        | -8.163 |
| Transitional Surface              | 49                | 45               | -8.163 |
| Inner Transitional Surface        | 4,000 49          | 4,000 45        | -8.163 |
| Conical Surface                   | 2,000 151         | 2,000 145       | -3.974 |
| Balked Landing Surface            | 15,000 153        | 15,000 150      | -1.961 |

3.2. Maps of obstacle limitation surface at the existing condition and the ultimate condition

The maps of areas in obstacle limitation surface of Kualanamu International Airport shown in figure 1 and figure 2. This area is shown for the ultimate condition in Kualanamu International Airport.
Figure 2. The obstacle of limitation surface of the ultimate condition.

Figure 3. The details of obstacle of limitation surface of the ultimate condition.
3.3. The districts region of the locations of obstacle limitation surface area in Deli Serdang Regency.

Table 2. Percentage of deviation high change.

| Areas                        | Districts                      | Existing Areas ($m^2$) | Ultimate Areas ($m^2$) | % changes |
|------------------------------|--------------------------------|------------------------|------------------------|-----------|
| Approach Surface and Inner Approach Surface | TanjungMorawa, Pantai Labu | 108,957,337            | 117,047,436            | 7.43      |
| Inner Approach Surface       | Beringin                       | 4,689,998              | 5,166,000              | 10.15     |
| Transitional Surface         | Beringin                       | 6,209,532              | 7,522,200              | 21.14     |
| Conical Surface              | Beringin, BatangKuis, Pantai Labu | 43,338,934          | 77,300,026            | 16.07     |
| Inner Transitional Surface   | Beringin, BatangKuis, Pantai Labu | 69,373,681          | 71,242,078            | 2.69      |
| Balked Landing Surface       | BatangKuis, TanjungMorawa, LubukPakam, Pagar Merbau | 578,361,410        | 602,132,238           | 4.11      |

Based on the digitation map, it was summarized that there were a number of districts in Deli Serdang would be affected by the increase of obstacle limitation surface areas such as TanjungMorawa, Pantai Labu, Beringin, BatangKuis, LubukPakam, Percut Sei Tuan, and Pagar Merbau. Hence, prior to constructing a development additional runway, there was a compulsory to inform all stakeholders surrounded these district areas to become aware of this development and in order to reduce social conflict.

4. Conclusions
The decreased in the vertical high and the increased of the horizontal anobstacle limitation surface areas was caused by the additional runway in Kualanamu International airport (from 1 runway to become 2 runways). The percentage of high change in obstacle limitation surface is 1.961% to 8.163%, the area change is 8.57%. The region of Deli Serdang which included obstacle limitation surface covered 7 districts.

Acknowledgments
The authors gratefully acknowledge that the present research is supported by PT. Angkasa Pura II, Kualanamu International Airport, Deli Serdang.
Reference

[1] KM No. KP 482 2018 Rencana Induk Bandar udara Internasional Kualanamu di Kabupaten Deli Serdang Provinsi Sumatera Utara

[2] KM 57 Tahun 2007 2007 Kawasan Keselamatan Operasi Penerbangan di Sekitar Bandar Udara Baru Medan Provinsi Sumatera Utara

[3] SKEP 48/III 2001 Pedoman Penelitian Rancangan Keputusan Menteri Perhubungan Tentang Kawasan Keselamatan Operasi Penerbangan di Bandar Udara dan Sekitarnya

[4] Annex 14 2013 Aerodromes Design and Operation Airport Services Manual (Canada: ICAO)