## **Summary**

UN-Habitat and ICAO have resolved to strengthen their cooperation through an MOU with a view to advising member States on technical and policy matters relating to aviation issues raised within the context of the sustainable integration of airports in urban areas and within national development programmes. It directly supports SDGs 9, 11, and 13, which respectively pertain to economic development, urban well-being, and climate change.

# Source: 🛞 ICAO NEWS RELEASE

Montréal and Quito, 20 October 2016: New UN agreement to foster sustainable development synergies between air transport and urban development

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Indian cities are witnessing immense demographic expansion due to migration from surrounding villages, leading to urban sprawl, housing demand, rise in cost of land. Many citizens all over India migrate to the cities for better jobs and education. Industries, trade and commerce activities and number of educational centers in cities attract floating population from all their surrounding villages and districts. This has expanded the cities in all directions and all aspects of development. With an urban sprawl of kilometers, these face the problems of congestion, pollution, everyday commuting to work place, competition, deforestation etc.

[Source: IACSIT International Journal of Engineering and Technology, Vol. 6, No. 1, February 2014 Study of High Rise Residential Buildings in Indian Cities (A Case Study –Pune City) Rupali Kavilkar and Shweta Patil]

A high degree of cooperation is required among Government, local authorities, Airport Operators and Property Owners to provide a safe environment for efficient operation of Aircrafts while allowing Vertical cities for Urban Development and optimum use of land for decongesting the Urban Sprawl.

Also the Guidelines used for permissible height analysis must take into consideration the FSI allotted by the Municipal Bodies. There has to be some association between the FSI allotted by MCGM and the permissible height zoning by AAI as both are regulating the 'Vertical Space' or the 'navigable airspace'. As of now there is no co-relation between them, both are independent of each other causing conflict in planning , execution and getting clearance for various development projects.

#### The need for revised Shielding Criteria based on increasing density of buildings in cities

[Source: IACSIT International Journal of Engineering and Technology, Vol. 6, No. 1, February 2014 Study of High Rise Residential Buildings in Indian Cities (A Case Study –Pune City) Rupali Kavilkar and Shweta Patil]

Cities can be categorized in four categories considering different philosophies: High Rise with High Density; High Rise with Low Density; Low Rise with High Density; and Low Rise with Low Density.

In India, a building greater than 75ft (23 m), generally 7 to 10 stories, is considered as high-rise. Also a building is considered to be high-rise when it extends higher than the maximum reach available to fire fighters. According to the building code of India, a tall building is one with four floors or more or a high-rise building is 15 meters or more in height.

#### [Source: National Building Code of India 2005, Government of India, New Delhi]

Most of the tall buildings in India are in the commercial capital Mumbai. More than 2500 high-rise buildings are already constructed. In addition more than thousand mid-rises exist already in the city. Mumbai is undergoing a massive construction boom, with thousands of tall buildings and about fifteen high-rise structures are under construction. Delhi and its surrounding regions are witnessing huge construction activities with 1500 already constructed high-rises.

Till a few years back, the maximum height of buildings in Pune was 36 meters. In November 2007, The Government of Maharashtra allowed construction of tall buildings in other cities also. Based on the approval of the State Government, the Pune Municipal Corporation permitted builders to construct 100 meter tall buildings.

With increasing density of high rise structures in cities, it is important to revise the Shielding criteria to include shielding from manmade structures / buildings which are permanent in nature.



www.globalcoordinates.net Dated June 29, 2019

# Shielding Criteria

# [Source: 'Airport Services Manual (Doc 9137-AN/898/2), Part 6, Control Of Obstacles, Second Edition-1983]

In many countries the principle of shielding is employed to permit a more logical approach to restricting new construction and prescribing obstacle marking and lighting. It also reduces the number of cases of new construction requiring review by authorities. Shielding principles are employed when some object, an existing building or-natural terrain, already penetrates above one of the obstacle limitation surfaces described in Annex 14. If it is considered that the nature of an object is such that its presence may be described as permanent, then additional objects within a specified area around it may be permitted to penetrate the surface without being considered as obstacles. The original obstacle is considered as dominating or shielding the surrounding area.

The Seventh Session of the AGA Division introduced the principle of shielding to JCAR Part 139. Though the Division recognized the use of shielding in the specifications of Annex 14, it did not draft specifications concerning the details of its employment. The Division did discuss how shielding should be employed but decided to leave this material as guidance for the present time.

It was generally agreed that the formula for shielding should be based on a horizontal plane projected from the top of each obstacle way from the runway and a plane with a negative slope of 10 per cent towards the runway. Any object which is below either of the two planes would be considered shielded. The permission to allow objects to penetrate an obstacle limitation surface under the shielding principle should, however, be qualified by reference to the need for an Aeronautical Study in all cases.

The shielding effect of immovable obstacles laterally in approach and take-off climb areas is more uncertain. In certain circumstances, it may be advantageous to preserve existing unobstructed cross section areas, particularly when the obstacle is close to the runway. This would guard against future changes in either approach or take-off climb area specifications or the adoption of a turned take-off procedure.

The permanency of the immovable obstacle which is to be considered as shielding an area should be given very careful review. An object should be classed as immovable only if, when taking the longest view possible, there is no prospect of removal being practicable, possible or justifiable, regardless of how the pattern, type or density of air operations might change.

#### Shielding Criteria, New-Zealand

#### [Source: https://www.caa.govt.nz/assets/legacy/rules/Rule\_Consolidations/Part\_077\_Consolidation.pdf]

Principles of Shielding are applicable when some **<u>object</u>**, an existing building or natural terrain already penetrates above obstacle limitation surfaces. If the obstacle is permanent (natural Terrain/ existing structure), then additional objects within a specified area around it can penetrate the surface without being obstacles.

a) An object that is determined by the Director to be a hazard in navigable airspace may not be required to be marked or lighted if the Director considers the object to be shielded.

b) An object that is of lower height than another object:

(1) Already considered to be a hazard in navigable airspace; and

(2) that is marked by standard obstacle marking or lighting—

May be considered to be shielded by the other object.

(c) An Aeronautical study may be required to determine whether an object that penetrates an obstacle limitation surface is shielded.

(d) A shielding object shall be permanent.

(e) For the purposes of paragraph (c) an object may be classed as permanent only if, when taking the longest view possible, there is no prospect of removal being practicable, possible, or justifiable, regardless of how the pattern, type, or density of air operations might change.

(f) Where the obstacle being shielded lies within the approach or take-off surface, or the transitional side or inner horizontal surface, it shall meet the criteria illustrated in figures C.1 and C.2 below in relation to the shielding object.

(g) Where the obstacle lies outside of the areas referred to in paragraph (f) it may be considered shielded if located within 600 m of the shielding object.



Fig C.1 (Shielding in Take-off and Approach Surface)



Fig

C.2 (Shielding in Transitional and Inner Horizontal Surface)

#### Shielding Criteria, Singapore

[Source: https://www.caas.gov.sg/docs/defaultsource/pdf/manual\_of\_aerodrome\_standards\_version\_1-9.pdf]

New obstacle located in the vicinity of an existing obstacle and assessed as not being a hazard to aircraft is deemed to be shielded.

Unless specifically directed by the Aerodrome and ANS Regulation Division, a shielded obstacle does not require removal, lowering, marking or lighting and should not impose any additional restrictions to aircraft operations.

Aerodrome and ANS Regulation division will assess and determine whether and Obstacle is shielded.

Only existing permanent obstacles may be considered in assessing shielding of New Obstacles.

#### **Shielding Principles**

#### Obstacles penetrating the Approach and Take off climb surface

An existing obstacle within the Approach and Take off climb area is called the critical obstacle. Where a number of obstacles exist closely together, the critical obstacle is the one which subtends the greatest vertical angle measured from the appropriate inner edge.

As illustrated in Fig 8-1, a new obstacle may be assessed as not imposing additional restrictions if:

(i) When located between the inner edge and the critical obstacle, the new obstacle is below a plane sloping downwards at 10% from the top of the critical obstacle towards the inner edge.



- (ii) When located beyond the critical obstacle from the inner edge end, the new obstacle is not higher than the height of the permanent obstacle
- (iii) When there is more than one critical obstacle within the Approach and Take off climb area and the new obstacle is located between the two critical obstacles, the height of the new obstacle is not above a plane sloping downwards at 10% from the top of the next critical obstacle.





#### Obstacles penetrating the inner and outer horizontal and conical surfaces

- (i) A new obstacle may be accepted if it is in the vicinity of an existing obstacle and does not penetrate the 10% downward sloping conical shaped surface from the top of the existing obstacle, i.e the new obstacle is shielded radially by the existing obstacle.
- (ii) A new obstacle may be assessed as not imposing additional restrictions if it does not exceed the height of an existing obstacle which is closer to the runway strip and the new obstacle is located perpendicularly behind the existing obstacle relative to the runway center line.

#### Shielding Criteria, United State of America:

#### [Source: http://tfmlearning.faa.gov/Publications/atpubs/AIR/air0603.html#air0603.html.1]

**Consideration**: Shielding is one of the many factors that must be considered in determining the physical effect a structure may have upon aeronautical operations and procedure.

**Principle**: The basic principle in applying the shielding guideline is whether the location and height of existing structures are such that aircraft, when operating with due regard for the shielding structure, would not collide with that structure.

**Limitations**: Application of shielding benefit is limited to:

**1.** The physical protection provided by existing natural terrain, topographic features, Or surface structures of equal or greater height than the structure under study; and

**2.** The structure(s) providing the shielding protection is/are of a permanent nature And there are no plans on file with the FAA for the removal or alteration of the structure(s).

**Guidelines**: Any proposed construction of or alteration to an existing structure is Normally considered to be physically shielded by one or more existing permanent structure(s), natural terrain, or topographic feature(s) of equal or greater height if the Structure under consideration is located:

**1.** Not more than 500 feet horizontal distance from the shielding structure(s) and in the congested area of a city, town, or settlement, provided the shielded structure is not located closer than the shielding structures to any heliport or airport located within 5 miles of the structure(s).

**2.** Such that there would be at least one such shielding structure situated on at least three sides of the shielded structure at a horizontal distance of not more than 500 feet.

**3.** Within the lateral dimensions of any runway approach surface but would not exceed an overall height above the established airport elevation greater than that of the outer extremity of the approach surface, and located within, but would not penetrate the shadow plane of the shielding structure. Air traffic shall coordinate with FPT before applying shielding criteria for precision approach surface penetrations.





#### **Considering Shadow Plane**

The term "shadow plane" means a surface originating at a horizontal line passing through the top of the shielding structure at right angles to a straight line extending from the top of the shielding structure to the end of the runway. The shadow plane has a width equal to the projection of the shielding structure's width onto a plane normal to the line extending from the top and center of the shielding structure to the midpoint of the runway end. The shadow plane extends horizontally outward away from the shielding structure until it intersects or reaches the end of one of the imaginary approach area surfaces;





#### Shielding Criteria, India

#### Ministry of Civil Aviation guideline S.O 84 date, 14 January 2010

#### Source: http://www.civilaviation.gov.in/sites/default/files/moca\_003378.pdf

Shielding principles are employed with respect to <u>natural terrain / duly authorized existing obstacles</u> which penetrate above the obstacle limitation surfaces described and as contained in this document, subject to Aeronautical Study, if considered necessary by the competent authority.

#### 4.1 Aerodrome and Ground Aids (AGA) parameters

4.1.1 The following criteria shall be applied for the purpose of applying shielding benefits for the proposed building or structure with respect to existing natural terrain/building structures.

4.1.2 The principle of shielding will not be applied in the transitional surface area.

<u>4.1.3 The principle of shielding shall be applied in the approach areas beyond 4000 meters of the inner edge of runway strip.</u>

<u>4.1.4 The principle of shielding shall be applied in the Inner Horizontal Surface (IHS) beyond radius of</u> <u>3000 meters from the nearest runway strip.</u>

4.1.5 The principle of shielding shall also be applied in conical and outer horizontal surfaces.

4.1.6 The shielding benefit is to be provided with respect to the <u>authorized structures/natural terrain</u> in a horizontal plane projected from the top of the obstacle away from the runway and on a plane having negative slope of 10% towards the runway. In case of Inner Horizontal Surface the benefit of the negative slope shall be applicable up to 3000 meters from the nearest Runway end or the Aerodrome Reference Point as the case may be. In case of approach surface the benefit of negative slope shall be applicable up to 4000 meters from the nearest runway end. In case of Conical and Outer Horizontal surfaces, shielding benefit of negative slope shall be restricted to same surface.

4.1.7 The following guidelines are provided for determining the areas where the shielding benefit would be applicable:

#### 4.1.7.1 Towards the runway (Negative slope)

(i) Draw a line from the highest point of the **reference terrain/obstacle** to the end of all runways for obstacles located within the Inner Horizontal Surface, Conical or the Outer Horizontal Surface.

(ii) The shielding benefit will cover the areas bound within the lines as in para 4.1.6 and para 4.1.7 (i).

(iii) In case of obstacle is located within the approach surface of any runway, the negative shielding shall be applicable to that particular runway only. The area shall be drawn by joining the highest point of the reference terrain/ obstacle to the nearest runway end. The dimension of the area shall be same as the dimension of the obstacle.

# 4.1.7.2. Away from the runway (Horizontal plane)

(i) For obstacles located in the Inner Horizontal Surface, Conical and Outer Horizontal Surface, draw a line from the Aerodrome Reference Point to the centre of the obstacle.

(ii) Draw the projection from the extremities of the obstacle away from the runway parallel to the line drawn as per para 4.1.7.2 (i).

- (iii) For obstacle located in the approach surface, draw a line from the nearest runway end to the centre of the obstacle.
- (iv) Draw the projection of the obstacle away from the runway parallel to the line drawn as per para 4.1.7.2. (iii).
- (v) The shielding benefit of horizontal plan shall be applicable to the obstacles located below the projection line drawn as per para 4.1.7.2 (ii and iv) as indicated in Appendix-E. 4.1.8.

Tall and skeletal obstructions such as isolated towers, chimney, masts, electric pylons, telephone and power lines and poles will not provide any shielding.

4.1.9. While providing the shielding benefit it shall be ensured that the minimum altitudes, of various segments of the published instrument approach procedures are not adversely affected.



#### Positive Shielding Plane In 3D



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#### Ministry of Civil Aviation guideline GSR 751 date 30th September 2015

[Source: http://nocas2.aai.aero/nocas/AAI\_Links/GSR\_751(E).pdf]

#### 4. Revised Shielding criteria

The principle of shielding is applicable w.r.t. **Natural Terrain**, already penetrating one of the obstacle limitation surfaces of an airport and it is not likely to be removed. The shielding criteria as explained below is applicable w.r.t. AGA and CNS surfaces.

4.1 The principle of shielding will not to be applied in:

I. Transitional surface area,

II. Approach surface areas, within 4000 meters of the inner edge of approach surface.

III. Inner Horizontal Surface (IHS), within a distance of 2500 meters from the runway centre line. In case of multiple runways, area encompassed by 2500M from centerline of all runways.

4.2 The following criteria shall be followed for the purpose of applying shielding criteria for the proposed structure with respect to existing natural terrain.

4.2.1 Proposed (shielded) object located beyond a distance of 2500M from runway centerline:

(i) Draw a line joining the centre point of the plot to the nearest runway end (runway code no. 3 & 4) or ARP (code 1 & 2) as the case may be. Shielding will be applicable w.r.t. applicable terrain within the area bounded by the two lines drawn parallel to the above line, at a distance of 600M on either side. A line, across the highest point of applicable reference (shielding) terrain, perpendicularly to the above parallel lines shall be drawn to delineate the areas for different type of shielding i.e. negative or equal to the horizontal plane passing through top of reference terrain (For the illustrations refer to Appendix–F and Appendix-G of Schedule VIII).

(ii) If the proposed structure is lying between the aerodrome and the reference terrain, a negative shielding of 10% shall be applicable. The shielding benefit of a horizontal plane, equal to reference terrain height, shall be provided in the area located in the opposite side away from the aerodrome (For the illustrations refer to Appendix–F and Appendix-G of Schedule VIII).



ILLUSTRATION OF SHIELDING CRITERIA FOR AIRPORT CODE NO.1 AND 2

Shielding benefit criteria for Site R.K Studio/ Godrej Properties



www.globalcoordinates.net Dated June 29, 2019

S.No.	Shielding Criteria	India	New-Zealand and Australia	United State of America	Singapore
1	Existing building Structures of permanent nature	х	$\checkmark$	$\checkmark$	$\checkmark$
2	Natural Terrain	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
3	Transitional Surface	x	$\checkmark$	$\checkmark$	$\checkmark$
4	Take-off and Approach Surface	Beyond the 4000 m	No restriction	No restriction	No restriction
5	Inner Horizontal Surface	Beyond the 2500 m	No restriction	No restriction	No restriction
6	Negative Shielding	$\checkmark$	x	x	$\checkmark$
7	Positive Shielding	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
8	Shielding Applicable in bounded area in Approach & Take-off Surface	600 M distance on either side from centre point of the shielded	90 m width of existing object	Horizontal distance from shielding structure not less than 500 feet	No restriction
9	Applicable shielding bounded Area in Inner Horizontal Surface	structure to the nearest runway end.	Within 600 m diameter of the shielding structure.		No restriction

\*\*MOCA should revise the Shielding Guidelines to include shielding from existing structures of permanent nature.

#### note.

x = symbol showing Criteria not Applicable  $\sqrt{}$  = symbol showing Criteria Applicable

# Comparison of shielding criteria used in other countries