International Civil Aviation Organization

Fifteenth Meeting of the APANPIRG ATM/AIS/SAR Sub-group (ATM/AIS/SAR/SG/15)

Bangkok, Thailand, 25 – 29 July 2005

Agenda Item 7: Review developments relating to CNS/ATM implementation

TOWER SITING VISBILITY ANALYSIS

(Presented by the United States of America)

SUMMARY

This paper provides an illustrative example of how human factors research and engineering impacts the return on investment of Federal Aviation Administration (FAA) projects. This is one of many human factors projects that contribute to the U.S. National Airspace System safety and capacity and help to improve efficiency, enhance effectiveness, and save money.

1. INTRODUCTION

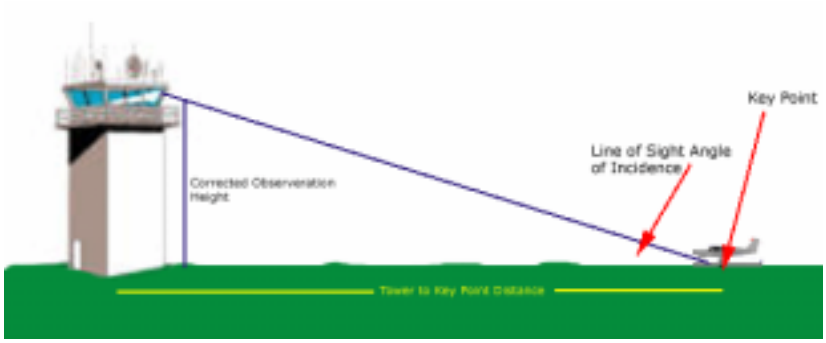
1.1 In the past, Airport Traffic Control Tower (ATCT) siting decisions have been significantly influenced by controller opinions and the upper height limits imposed by terminal instrument procedures. The FAA had no means to measure quantitatively the improvement in air traffic controller visibility that can be gained by changing the tower height and location on the airport surface, and there was no required minimum criterion for tower height.

1.2 The objective of the Human Factors Tower Siting Project was to incorporate human vision capability and limitation considerations (for object detection and airport surface viewing perspective) in the tower siting process and in the revised order (FAA Order 6480.XX).

2. DISCUSSION

2.1 A revised FAA Tower Siting Policy has been released for comment and interim use (06/2005). It establishes requirements and criteria, as well as a tool, that incorporate quantifiable human visual perspective and performance capabilities to support tower height and location decisions at least cost. The visibility analysis tool is available on the Internet to all tower siting project teams (http://www.hf.faa.gov/visibility) and is being used by them in planning for new control towers.

2.2 Where the average line of sight (LOS) angle of incidence for current towers is 0.88 degrees and the average LOS for proposed towers is 1.48, the minimum LOS criterion has been established at 0.80 degrees. The tendency for increased height for proposed towers occurs for multiple reasons, but may also reflect an inability to limit increases due to the absence of minimum human performance requirements and evaluation measures.



2.3 FAA headquarters human factors specialists and Airport Facilities Terminal Integration Laboratory personnel at the WJHughes Technical Center devised an experimental methodology to evaluate the human performance characteristics affecting tower siting decisions and conducted tower siting simulations to establish a baseline of a controller's visual capabilities. Research results are used to determine requirements for future tower construction projects, ensuring safe minimums and constraining costs of the nation's airport investments.

2.4 This effort supports the FAA Flight Plan Goals for Increased Safety regarding the FAA Safety Management System (SMS) initiative to update the FAA Order for tower siting; establishes quantifiable measures of human performance for tower siting decisions; and leverages 40 years of work on the probability-of-discrimination (detection, recognition, and identification) done by the Army Research Laboratory in Adelphi, Maryland.

2.5 The cost was $80,000 plus 1/4 staff position.

2.6 **Benefit**: Potential cost savings are estimated at $5 million/year based on an estimated average of 7 towers, $40,000 per foot costs, and expected decrease in height of 20 feet per tower, where current FAA tower construction is:

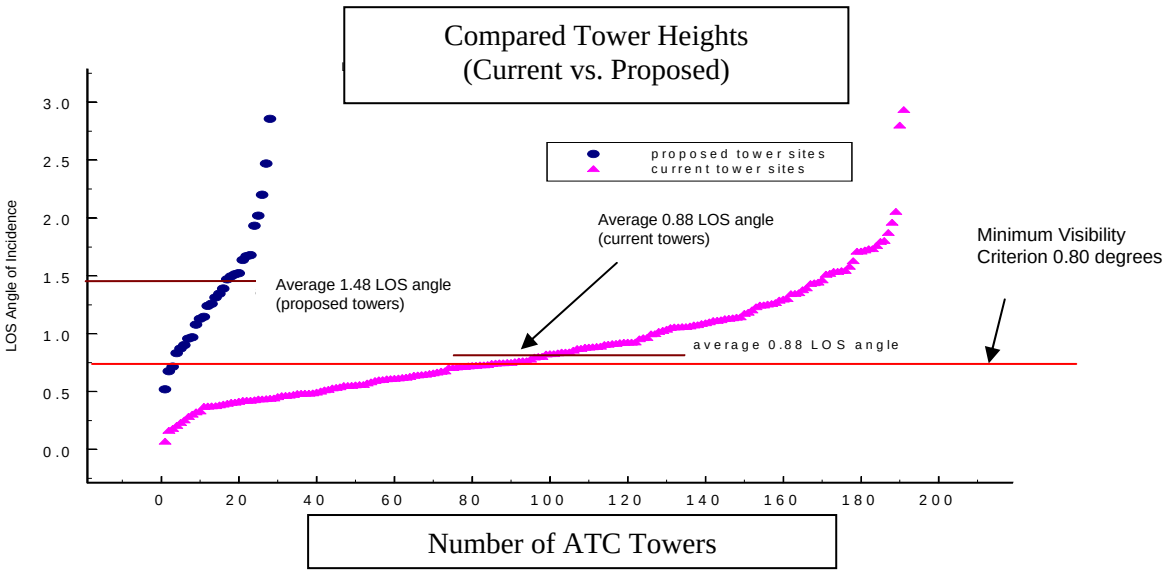
- Averaging 6-10 towers constructed per year
- Costing $30-50,000 per foot
- Expected to decrease tower heights at least by 10-40 feet per tower

3.0 CONCLUSIONS

3.1 The human factors discipline addresses the system and user requirements from the perspective of measuring human-system performance and differs from how some programs utilize user's personal opinions and preferences to determine design requirements. Conclusions include:

- Determining and adopting appropriate human performance measures enable programs and projects to define baseline criteria and to assess trends during design, development, and implementation.
- In addition to enhancing the safety and capacity of the NAS, human factors research contributes to cost savings and project effectiveness through return on investment.
- Efforts should continue to exploit the systematic application of human factors research and engineering, leveraging opportunities that provide the scientific foundation for investment decisions that result in cost savings and efficiencies across the NAS.

3.2 The meeting is invited to note the information provided in this paper.


Compared Tower Heights
(Current vs. Proposed)
proposed tower sites
current tower sites
Average 0.88 LOS angle
(current towers)
Minimum Visibility
Criterion 0.80 degrees
Average 1.48 LOS angle
(proposed towers)
average 0.88 LOS angle
LOS Angle of Incidence
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
20
40
60
80
100
120
140
160
180
200
Number of ATC Towers