A presentation by
ATC Guild (India)

On

Stress in Air Traffic Control

And

Revision of Stress allowance
Stress in Air Traffic Control

- **What is stress?**

  It is not easy to properly define what stress is, although it is quite a common experience for everyone.

  Stress is a part of everyday life and not necessarily a negative phenomenon, being a physiological stimulus usually connected with human-environment interactions.

  However, it can become a harmful risk factor for health when it is perceived as an imbalance between an excess of demands and the individual ability to meet them. This causes a perturbation of the psycho-physical equilibrium, taxing physical, psychic and behavioural responses aimed at coping with it. If this coping fails, stress can have harmful consequences on physical, mental and social well-being, with high costs both for the individual and society.

  Stress at work can be generated by job demands, environmental conditions, work organization and human relations; its impact on job satisfaction, performance efficiency and health can vary widely depending on the psycho-physical characteristics and coping resources of individuals, as well as on the social support received.

- **The sources of stress in air traffic control**

  Air traffic controllers (ATCs) are generally considered one of the working groups having to deal with a highly demanding job. In fact, it entails a complex set of tasks requiring very high levels of knowledge and expertise, as well as the practical application of specific skills pertaining to cognitive domains (e.g. spatial perception, information processing, logic reasoning, decision making), communicative aspects and human relations.

  To have an idea of its complexity, it is sufficient to mention that, according to a job analysis of en-route controllers carried out by a group of American researchers, six main activities can be identified (i.e. situation monitoring, resolving aircraft conflicts, managing air traffic sequences, routing or planning flights, assessing weather impact, managing sector/position resources), which include 46 sub-activities and 348 distinct tasks. For example, the relevant cognitive/sensory attributes required for high performance levels at radar workstations are spatial scanning, movement detection, image and pattern recognition, prioritizing, visual and verbal filtering, coding and decoding, inductive and deductive reasoning, short- and long-term memory, and mathematic and probabilistic reasoning.

  It is evident that the cognitive and operational processes of an ATC vary not
only according to the number of aircraft under control, but also with the number and complexity of problems to be solved.

The ATC must constantly reorganize his or her system of processing flight information by changing operating methods (in particular, cognitive processes, conversation, coordinating with assistants, anticipation and solving problems) as they arise and interact with each other. This is carried out by means of the precise and effective application of rules and procedures that, however, need flexible adjustments according to differing circumstances, often under time pressure.

At the same time, the job includes high levels of responsibility, not only with regard to risking lives, but also for the high economic costs of aeronautical activities.

According to several surveys, the main sources of stress reported by air traffic controllers are connected both to operative aspects and to organizational structures (Table 1). For the former, the most important are peaks of traffic load, time pressure, having to bend the rules, limitations and the reliability of equipment. The latter are mainly concerned with shift schedules (night work in particular), role conflicts, unfavourable working conditions and the lack of control over work.

These stress factors can affect not only job satisfaction, but the well-being and safety of ATCs. In fact, as the workload increases the ATC tends to employ more procedures which are less time consuming, together with a progressive reduction to the minimum of flight information and the relaxation of certain self-imposed qualitative criteria. It is evident that the number of decisions to be made becomes a stressful condition when the controller’s decision-making capacity is stretched to the maximum; this can lead, in case of overload, to a very risky situation defined as “loss of picture”.

On the other hand, it is frequently reported that, paradoxically, many errors often occur during periods of light or non-complex traffic. These points to the great effort required to regulate the psycho-physical reactions, maintaining high level of arousal and vigilance even in conditions of “underload”.

Table 1. Main sources of stress for ATCs

**Demand:**

- number of aircraft under control
- peak traffic hours
- extraneous traffic
- unforeseeable events

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Operating procedures:

- time
- pressure having to bend the rules
- feeling of loss of control
- fear of consequences of errors

Working times:

unbroken duty periods, shift and night work

Working tools:

limitations and reliability of equipment, VDT, R/T and telephone quality equipment layout

Work environment:

lighting, optical reflections noise/distracters microclimate bad posture rest and canteen facilities

Work organization:

role ambiguity relations with supervisors and colleagues lack of control over work process salary public opinion
The consequences on health and well-being

If we consider stress as the external demands upon an individual, it is clear that stress for air traffic controllers is connected, on the one hand, with the intrinsic characteristics of the job and, on the other hand, with the work organization and conditions in the workplace. It is important to bear in mind that the psycho-physical responses of individuals also depend on their resources, defined both in terms of personal characteristics and coping strategies.

According to the “demand/control/support” model on stress at work, high stress levels and consequent troubles and illnesses are more likely to develop in work activities where there is high psychological demand, but low decision latitude and inadequate social support at the workplace (“high strain job”). On the other hand, jobs having not only high psychological demands, but also a high decision latitude and adequate social support, are likely to determine an active behavior that stimulates learning, motivation and labour productivity.

As far as air traffic control is concerned, it is evident that the job entails, on the whole, high psychological demands while being subjected to a considerable degree of external control.

This feeling of lack of personal influence that ATCs often complain of can be a powerful stressor, also taking into account that the job requires high levels of responsibility.

However, both “demand” and “control”, as well as “social support”, can vary widely according to several factors dealing with different working situations, e.g. work environment, equipment, work planning and procedures, workload distribution, team composition, working hours, rest pauses, shift schedules and human relations.

Furthermore, the consequences on an ATC’s performance and well-being may differ widely among individuals in relation to many factors dealing with age, life styles, life events, work experience, personality traits (introversion, anxiety, type A), behavioural characteristics (mood, sleeping habits, morningness), attitudes, motivation, and physical and mental health. Moreover, many other factors related to social conditions can play an important role in this respect, e.g. socio-economic status, housing conditions, commuting, family attitudes, social support and integration.

Therefore, all these aspects can have more or less influence on an ATC’s job satisfaction, health and well-being according to different circumstances (Figure 1). They can interact and interfere with each other, giving rise to not only possible additive or multiplicative, but also subtractive effects, so that it is often very difficult to evaluate and compare the effective stress and strain in different groups and individuals. This is the reason why many studies on the stress of air traffic controllers reported apparently contradictory findings.
Main consequences of stress for air traffic controllers

**SOURCES OF STRESS**
- Work demands
- Operating procedures
- Working times
- Working tools
- Work environment
- Work organization

**SHORT-TERM EFFECTS**
ON: Brain and cardiac activity
- Hormonal excretion
- Performance efficiency
- Mental processes
- Operative behaviour

**LONG-TERM EFFECTS ON HEALTH:**
- Hypertension
- Ischaemic heart disease
- Diabetes
- Peptic ulcers
- Psychoneurotic disorders

**INFLUENCED BY:**
- Personality
- traits
- Skill
- Aptitude
- Motivation
- Experience
- Operating behaviour
- Coping strategies
- Social support
With regard to the short-term effects, an ATC’s responses can be documented in terms of changes in hormonal secretion (e.g. adrenaline, non-adrenaline, cortisol), heart rate, blood pressure, muscular activity, cerebral waves, work performance (errors) and behaviour (sleeping, smoking, eating and drinking habits). These can indicate a normal, physiological adaptation of the individual to external stimulation, as well as an excessive strain due to an imbalance between demands and resources.

Most research indicates that these responses are in some way related to the workload, which can be evaluated in terms of the number of aircraft under control or expected to come under control, peak traffic counts, duration and type of communications, tight work schedules, and number and complexity of problems to be solved. However, big differences among air control centres can be recorded, mainly in relation to air traffic density.

On the other hand, they appear to be greatly influenced by subjective factors, such as personality traits (anxiety, introversion), aptitude, skill, ability, motivation, experience and operating behaviour.

In the long term, some studies indicate that this demanding occupational activity may be a risk factor for stress-related symptoms, such as headaches, chronic fatigue, heartburn, indigestion and chest pain, as well as for serious illnesses, such as hypertension, coronary heart disease, diabetes, peptic ulcers and psychoneurotic disorders.

It is quite easy to foresee the high costs from both the existential and the economic point of view that these negative consequences of stress can have, not only for the single person, but also for companies and society.

Therefore, prevention and control of stress becomes a compulsory target for employees, in order to safeguard their physical, mental and social health; for companies, in order to improve the efficiency and reliability of the service; as well as for society as a whole, in order to guarantee the highest levels of safety and comfort for all included and affected by this very important work activity.

**How to prevent stress at work**

An effective strategy aimed at reducing stress should address both the causes and the consequences of stress, thus acting upon all factors involved concerning work organization, as well as the personal resources and social conditions of the controllers.

The possibility of making changes and improvements in job demands is determined mainly by technical factors related to the development of scientific...
knowledge with regard to air flight and control systems. Implementing new methods of automation in air traffic control activities, for example, could profoundly change job demands and characteristics. One result of such changes could be a modification in conditions which are known to cause stress.

On the other hand, specific arrangements of work organization and careful attention to the psycho-physiological conditions of ATCs are just as important tools capable of reducing stress and improving the comfort and well-being of operators.

In order to have an understanding of the possible practical interventions for stress prevention and attenuation, we can refer to the model of the stress development process reported in Figure 2.

As can be seen, we have several possibilities of intervention at different levels, which can have a different impact and effectiveness in relation to the causal factor they deal with and to their congruence with the specific environmental and personal conditions.

With respect to the particular aspects of an ATC’s job, we will examine the possibilities at the different levels according to the following scheme, also giving some examples of programmes or interventions carried out by some ATC companies, agencies or institutions.

**Figure 2. A model of the work stress development process and interventions**

![Figure 2. A model of the work stress development process and interventions](image-url)
Intervention on the external socio-economic environment

Legislation, international and national directives
Social support

Intervention on technology and work organization

Improving job planning and reliability of the work systems
Reduction of working times and arrangement of working teams and rest pauses in relation to the workload
Arrangement of shift schedules according to psychophysiological and social criteria
Participation in decision making

Intervention in working place and task structure

Improving the work environment
Lighting
Noise
Microclimatic conditions and indoor air quality
Arranging workplaces according to ergonomic criteria
Workstation design
Working with visual displays units
Sitting postures

Intervention to improve individual responses and behaviour

Individual ways of coping with stress
Selection and training
Counselling and other supporting measures at company level

Specific intervention for health protection and promotion

Appropriate medical surveillance

Intervention on the external socio-economic environment

Legislation, international and national directives

The Air Navigation Commission of the International Civil Aviation Organization (ICAO) has formulated the following objective for the task: "To improve safety in aviation by making States more aware and responsive to the importance of human factors in civil aviation operations through the provision of practical human factors material and measures developed on the basis of experience in
States”.

It is, therefore, necessary that states, organizations, companies and agencies involved in air traffic control make constant efforts for a more and more widespread exchange of know-how, expertise and guidelines to make possible a standardization and an effective integration of information services, flight data and air traffic management.

This is the main goal of the ICAO project on the Future Air Navigation System (FANS), that deals with a combination of satellite technology and the best of line-of-sight systems to provide an air navigational system which will overcome many of today's deficiencies on a global scale.

- **Social support**

Social support is a crucial point in stress management. According to the Karasek and Johnson model, this is one of the three factors that concur in determining stress conditions.

It can be seen in two main aspects:

(a) the availability of social services aimed at satisfying ATCs’ needs. They concern, for example, transport facilities for reducing commuting times, canteen and sleep facilities, and housing conditions;

(b) the recognition at a social level of the importance of ATCs’ activities and, consequently, its appreciation by the general population.

**Intervention on technology and work organization**

- **Improving job planning and reliability of the work systems**

The passage from the old procedural methods to modern assistance, under total radar coverage of air space, is the main factor which enables a "jump in quality", not only in terms of work efficiency, but also in terms of stress levels, by reducing cognitive, memory and communicative loads as well as uncertainty and unforeseeability of the situations (that are, in most cases, the main sources of strain).

The further technological passage to operating under “multi-radar” assistance permits a further increase in levels of reliability and safety as well as a decrease in stress levels.
The improvement in coordinating the information flow among the centres in order to assure an increasingly safe, regular and expeditious air traffic flow is the other milestone which allows ATCs to operate safely and quietly.

This is made possible by modernizing the telecommunication and radio assistance systems and improving the efficiency and reliability of equipment, as well as by the progressive automation of the aeronautical information service, flight data processing and air traffic management.

These improvements allow for better planning of air traffic and, consequently, a more balanced workload among centres, sectors and individual ATCs. These improvements may also subsequently reduce the possibility or the seriousness of many unforeseen situations, by allowing for more reliable information and more time for solving problems and making decisions, while eliminating many stressful and risky traffic peaks.

It is clear that the introduction of advanced automated systems in air traffic control activities can profoundly change job demands and content; therefore, it has to be carried out very carefully.

The goal of progressive automation is to maximize system safety and efficiency by reducing human workload and error. However, it can also increase some problems related to both cognitive processes and operative procedures. There is a justifiable concern for increased human boredom, decreased motivation, loss of situational awareness, over-reliance on and misuse of automated systems, and deterioration of skill.

Regarding information processing, it has to be taken into account that the cognitive competence of controllers consists of simultaneously mastering part of the procedure by application and/or adaptation type. For the moment, it is the controllers themselves who “decide” about this division according to their personality and cognitive structure. With automated workstations, this division will be taken over by the machine, and the controller will then only need to apply or adapt. Some may suffer from this and gain the impression that they can no longer

4.2 Reduction of working times and arrangement of working teams and rest pauses in relation to the workload

The mental effort, required to maintain the highest level of attention and vigilance, as well as to safely and effectively face the task in terms of cognitive and memory load, can vary widely in relation to air traffic density and connected
Therefore, to guarantee the best level of performance efficiency avoiding excessive mental stress and fatigue, particular attention has to be paid to arranging duty periods.

In relation to the peculiarity of the job and the characteristics of the demands, it is worth stressing that one of the most important aspects in this domain is flexibility, which should be used in scheduling duty periods and arranging working teams and sectors according to the air traffic density.

For example, the Committee on the Regulation of Air Traffic Controllers’ Hours in the United Kingdom, after a wide survey on workloads, hours of duty, sleep, performance and fatigue, concluded that the regulation of working hours should be aimed at ensuring, as far as reasonably possible, that controllers’ fatigue does not endanger aircraft, and thereby to assist controllers in providing a service safely and effectively.

(a) Duty periods:

— the length of the duty period should not exceed ten hours (extendable to 12 hours in special circumstances), and should be adjusted according to the workload;
— an interval of no less than 12 hours should be scheduled between the conclusion of one period of duty and the commencement of the next period of duty;
— Weekly Off shall be provided and the working hours shall be reduced.

(b) Breaks during operational duty:

— no operational duty shall exceed a period of two hours without there being taken, during or at the end of that period, a break or breaks totaling no less than 30 minutes;
— during periods of high traffic density, the possibility of having more frequent short breaks (ten minutes) should be provided;
— a sufficiently long break for meals should be allowed, providing adequate canteen facilities to assure hot and good quality meals. (c) Holidays:
— during any consecutive period of 365 days, no fewer than ten days of total holiday entitlement shall be taken in periods of no less than five consecutive days.

4.3 Arrangement of shift schedules according to psychophysiological and social criteria

Shift work, in particular night work, is a further stress factor for the ATCs due to its negative effects on various aspects of their lives, in particular as concerns:
(a) Disturbances of the normal biological rhythms, beginning with the sleep/wake cycle
(b) changes in work performance and efficiency over the 24-hour period, with consequent errors and accidents as potential outcomes;
(c) negative effects on health and well-being, including troubles with the digestive function (disturbances of appetite, gastro duodenitis, colitis, peptic ulcers), nervous system (sleep deficit, anxiety, depression) and cardiovascular systems (ischemic heart diseases);
(d) social problems, resulting from difficulties in maintaining the usual relationships both at the family and social levels, with consequent negative influences on marital relations, children’s education and social contacts.

Recent studies and research have resulted in some recommendations for the design of shift-work systems aimed at avoiding or reducing dangerous effects on health, well-being and efficiency of shift workers. They can be summarized in the following points:

1. Adopting a rapidly-rotating shift system, changing work shifts every one or two days instead of every week (or longer), in order to cause less disturbance to the normal circadian rhythm of body functions, including performance.
2. Reducing the number of consecutive night shifts as much as possible (one or two at most), and having a day's rest after the night-shift period. This prevents accumulation of sleep deficit and fatigue, and allows a quicker recovery.
3. Delaying the beginning of the morning shift (e.g. at 07:00 or later) to allow a normal amount of sleep and to ensure the “REM sleep”.
4. Preferring the forward rotation (e.g. morning-afternoon-night) to the backward one (e.g. afternoon-morning-night) to allow a longer period of rest between shifts. The forward rotation also parallels the “natural” tendency of body functions to lengthen the circadian rhythm over 24 hours when in “free-running” conditions (without external synchronizers).
5. Adjusting the length of shifts according to the physical and mental workload: day shifts should be shorter, whereas night shifts could be longer if the workload is reduced and there are sleeping facilities.
6. Giving the possibility of a short sleep or naps during the night shift, arranging proper sleep facilities. This has been found to have favourable effects on performance, physiological adjustment and tolerance of night work.
7. Keeping the shift rotation as regular as possible, so that the shift cycle will not be too long and will include some free weekends. This allows a better organization of personal, family and social life.
8. Arranging a sufficiently long pause (45 to 60 minutes) for meals during the work shift, and providing hot meals.
Individuals should also adopt some personal strategies, in particular as concerns their sleeping and eating habits, such as:

(a) Keeping to a tight sleeping schedule while on shift and night work and, as much as possible, avoiding disturbances (e.g. arranging the bedroom so that it is as silent and dark as possible; using ear plugs; making some arrangements with family members and neighbours).
(b) Avoiding the use of sleeping pills, save in exceptional cases, and only under medical control.
(c) Trying to adhere to the usual meal times, which can act as a good synchronizer of body functions.
(d) Eating light meals no later than two hours before going to sleep; avoiding caffeinated drinks and alcohol; relaxing before going to sleep (light exercise, reading, watching television, listening to music).
(e) During the night shift, having the main meal preferably before 01:00; thereafter, consuming only light snacks with a high carbohydrate level and soft drinks (fruit juices, milk).

The length of the work shifts is inversely associated with the traffic load, the morning and afternoon shifts being shortened to seven hours, in relation to higher air traffic loads, and the night shift being longer (11 hours) in relation to lower air traffic loads. Moreover, during the night shift, controllers are allowed to have long rest pauses alternatively, during which they can take naps in properly arranged rooms.

This has been found to be very helpful in overcoming sleepiness and maintaining alertness and performance efficiency. In fact, in a study concerning their psycho-physical reactions, the examined controllers were shown to be maintaining a normal circadian synchronization of body rhythms, and high levels of awareness and alertness (documented by mood and physical fitness rating scales, as well as by tests of performance and hormonal excretion) also during the night, in spite of the external understimulation.

Furthermore, the Committee on the Regulation of Air Traffic Controllers’ Hours in the United Kingdom, has recently proposed that:

— no more than two night shifts may be worked in immediate succession;
— upon the conclusion of two night shifts in immediate succession, there shall be an interval of a minimum of 54 hours before the commencement of the next period of duty;
— delaying shift systems should be preferred to advancing systems.
5. Intervention in working place and task structure

- Improving the work environment

Particular attention has to be given to ensuring that environmental conditions in the control centres are suitable and comfortable as concerns, in particular, lighting, noise and microclimatic conditions.

(a) Lighting

Taking into consideration that the ATC's task is performed almost exclusively in front of a visual display unit, particular attention should be paid to providing lighting conditions which favour an optimal visual performance.

Lighting conditions are completely different inside the regional centres and the towers.

In the radar centres, dim light (under 200 lux) is usually used to favour the visual contrast on the screen. It has to be considered that the introduction of modern screens are brighter and in colour, allows an increase of the illumination levels in the control room (up to 500 lux), thus avoiding excessive (and troublesome) luminance contrasts between central and lateral visual fields, making the environment more stimulating, thus increasing vigilance and alertness.

The lighting should be indirect, obtained preferably by mixing natural and artificial light directed onto the ceiling and the walls and thus reflecting into the room. This gives a diffuse lighting in the work environment without shadows and glare. Each artificial lighting unit should contain two or more phase-shifted tubes to avoid flickering, which is extremely annoying, causes visual discomfort and makes the reading of the different traces on the screen more difficult.

Inside the towers, the opposite is the problem. It is necessary to avoid excessive illumination levels due to external bright light using both anti-reflection glass and curtains; it is also important to have the possibility of positioning and shielding the visual display units to avoid indirect glare due to bright reflections on the screen.

(b) Noise

The noise levels recorded inside control rooms are usually under the risk level for loss of hearing, but can have significant effects in terms of interference with speech communication, the disturbance of mental concentration and annoyance.
It is worth considering the peculiarity of verbal communication, carried out in a foreign language for most of the pilots and ATCs, and containing many unfamiliar, technical and cipher words.

The main sources of noise are represented by conversations, manual operations (e.g. manipulations of strip supports) and office machines (printers, telephones, photocopiers, etc.).

Therefore particular attention has to be paid in order to stop background noise from exceeding 45-50 dB by installing quieter office machinery, arranging work sectors in order to have better sound protection from each other, and installing more insulating headsets and more sensitive microphones.

**Microclimatic conditions and indoor air quality**

A comfortable working temperature is another important factor supporting the maximum efficiency of performance. It is well-documented that conditions of thermal discomfort favour loss of concentration and efficiency of mental tasks with a consequent increase of errors and irritability.

Microclimatic conditions must be maintained within the range of thermal comfort, that is air temperature between 20 and 24°C, humidity between 30 and 70 per cent, and air velocity between 0.05 and 0.5 m/sec.

To ensure these conditions, it is necessary to install adequate air conditioning systems which must be maintained efficiently to guarantee a good indoor air quality.

Indoor air, in fact, can be polluted both from human activities (odours, exhaled carbon dioxide, smoking) and by environmental contaminants (chemical substances, microbes). Therefore, it must be periodically changed (at least three times per hour) and purified (passing through adequate filters) in order to avoid people complaining of symptoms related to the so-called “sick building syndrome” (lethargy, tiredness, headache, blocked nose, dry eyes, sore throat, wheeziness, cough, general itchiness) that cannot only disturb work performance, but also cause sickness and absenteeism.

- **Arranging workplaces according to ergonomic criteria**

  **Workstation design**

  Particular attention has to be paid to the configuration of the workstation, in particular as concerns the console layout in terms of the positioning of radar screens and auxiliary displays, the disposition of commands and controls, and the design of the keyboard and other interfaces.

  Further standardization of the panel layout is required. Information and
controls must be easy to understand and input devices easy to operate, according to logical processes of mental reasoning: delays and errors may occur because of confusing, misleading or excessively confusing documentation and information, poorly located knobs and levers, or lack of proper coding causing mismatches and mistakes.

Data displays containing flight information should preferably be located beside the radar screen, whereas the auxiliary displays showing maps or other complementary information can be placed above it.

High resolution and multi-colour displays are preferred; keyboards, rolling balls or joysticks should be movable to accommodate individual preferences; headset jacks must be positioned on both sides of the table and should not protrude.

It is also important to arrange the layout of the workplace in order to avoid glare caused by excessive brightness contrasts between different objects and surfaces; it causes discomfort and hampers the comprehension of the information. The displays should be shaded and the surfaces matte, avoiding the use of reflective materials and bright colours on table-tops and consoles. The luminance contrast between the screens and surrounding surfaces (plan-table, console frames, documents, keyboards, strips) should not exceed the ratio of 1:10.

The most advanced display systems allow for better performance with greater comfort because of their greater width, more favourable visual contrast, higher reliability, greater possibility of storing and retrieving information, and a better control layout.

On the other hand, particular attention has to be given to software ergonomics that can offer great possibilities for improving presentation, comprehension and processing of information. With regard to this, it has been proved that an appropriate use of colours, symbols, line shaping, windows and figures facilitates and hastens data recognition and extraction.

However, it is worth mentioning that drastic changes in workstation design and man-machine interfaces, often made possible by technological improvements, should be adopted very carefully, as they can cause excessive stress and decreased performance due to difficulties in the adaptation of mental processes and operating procedures.

With automated workstations, the controllers have less to do with telephoning, listening and passing on information. These interpersonal communications can have an influence on the method of work and the search for solutions. Reduction of verbal and non-verbal communication might lead to a feeling of isolation and a poorer internal atmosphere;
therefore, greater emphasis should be placed on the development of adequate levels of communication.

The abolition of paper strips should also be carefully considered. For most controllers, they fulfil a structuring role at a cognitive level and, in addition, they play an extremely important psychological role of reassurance. (particularly in case of unforeseen breakdowns). There is nothing to prove that these psychological functions will be fulfilled by electronic strips, even though the technical functions will certainly be perfectly assured.

**(b) Working with visual display units**

The interaction between the ATC and a visual display terminal are mainly characterized in terms of data acquisition and interactive communication. The ATC has a continuous dialogue with the radar-computer system by calling up information, scanning traces, inputting, reading and deleting data. The controller concentrates mainly on the radar screen and periodically glances a the side displays and keyboard.

The radar screen should be placed in the centre of the visual field and should be adjustable in height, distance and angle to give the operator the possibility of arranging the best working position in order to avoid, on the one hand, prolonged contraction of the neck muscles and, on the other hand, an excessive effort of visual adjustment with consequent visual discomfort and fatigue. Therefore, it is recommended that the screen be placed within a viewing angle of 5° above and 30° below the horizontal plane of sight, and that the eye-screen distance is between 50 and 70 cm to facilitate visual adjustment.

To give the operator the possibility of coming closer to the screen in order to focus better on traces in moments requiring particular attention, it is necessary that the table-top be not overly large but, at the same time, able to support the arms without interference with the keyboard.

**(c) Sitting postures**

The ATC usually remains seated in front of the console, changing position slightly according to the working conditions. The ATC normally sits in the middle of or forward on the chair with his or her arms on the table-top when he or she is actively operating and needs precise control of the radar screen, and leaning on the backrest when he or she is on stand-by.

A prolonged, constrained sitting posture causes musculo-skeletal discomfort and pain, particularly at the level of the neck, the shoulders and the lumbar tract.

In order to avoid or alleviate such disturbances, it is important to use suitable
chairs which allow a comfortable sitting posture while working, as well as useful muscle relaxation while on stand-by or resting in front of the screen.

A good chair should be designed for a forward and reclining sitting posture, adjustable in height and angle, rotating on a five-legged base. It should also have user-friendly controls, have wide arms and a high backrest, a pad for lumbar support and a head-rest. The seat should be made of a sufficiently resistant padding of foam rubber covered with non-slip and permeable material, and it should also have a slight hollow and a rounded front edge turned upwards about 4 to 6 degrees above the horizontal plane.

The break periods between operational duty should also be used as “postural pauses”, the controller should stand and walk around, stretching his body.

Moreover, a programme for improving physical fitness should be planned, aimed at preventing lower-back pain by providing gymnasiums to be used by the ATCs during their relief periods. There should also be technical guidance aimed at showing the most appropriate exercises that should be done for the most effective “postural pause”.

- **Appropriate medical surveillance for health protection and promotion**

Because of the specific requirements of the task, it is necessary that operators not only possess high intellectual and operative skills, but that they are also in good health (both physical and mental) in order to guarantee the highest levels of vigilance and performance at all times.

**Therefore, good medical surveillance is essential to ensure that operators are in good health and are able to carry out their job without unnecessary stress. In fact, the fear of losing their licence (and the accompanying economic benefits) because of health problems is often a further stress factor for the controllers.**

Consequently, the application of the precise norms and recommendations, defined by the International Civil Aviation Organization (ICAO) for the medical certification of licence holders, must be regarded as a preventive measure rather than a fitness programme.
During these medical checks of ATCOs, doctors should pay particular attention to specific complaints or illnesses, as well as to personality characteristics and coping strategies, with the aim of defining possible stress-related disorders and suggesting further preventive measures.

Therefore, medical surveillance should be converted from the predominant aspect of formal certification of “fitness for work”, derived from the lack of evidence of significant troubles and illnesses causing a decrease in medical fitness, into a more positive approach aimed at preserving the controller's health and well-being at best.

This deals with the above-mentioned guidelines and education programmes on preventive health measures (e.g. sleep, diet, smoking, physical fitness, rehabilitation), as well as to positive personal behaviours which are able to enhance job satisfaction and the psycho-physical condition.

Taking into account the different factors that can influence resistance and tolerance to stress, constant attention has to be paid to give social support to those controllers who may be expected to encounter more difficulties in coping with stress on the basis of their psycho-physiological characteristics, health situation and living conditions.

Taking into consideration that the above-mentioned disorders are, in most cases, a manifestation of chronic-degenerative processes (for which medical therapy has little, if any, effect) and that stress is one of the main risk factors, it is clear that preventive health measures and proper medical surveillance have a basic role to play in preserving well-being and performance efficiency of air traffic controllers.
(PART II)
PROPOSAL FOR REVISION OF STRESS ALLOWANCES

I) Sources and consequences of stress in air traffic control:

Surveys show that the main sources of stress reported by air traffic controllers are related both to the operative aspects of their job and to organizational structures. In the former case, the most important factors are peaks of traffic load, time pressure, resolving conflicts in the application of rules, and the limitations and reliability of equipment. The factors relating to organizational structure mainly concern shift schedules (and particularly night work), role conflicts, unfavourable working conditions and the lack of control over work.

Analysis has emphasized the complexity of the work of air traffic controllers. For example, the cognitive/sensory capacities required for high performance at radar workstations include spatial scanning, movement detection, image and pattern recognition, prioritizing, visual and verbal filtering, coding and decoding, inductive and deductive reasoning, short- and long-term memory, and mathematical and probabilistic reasoning. Air traffic controllers are also among the groups of workers who are most exposed to critical accidents which cause unusually strong emotional reactions, such as air accidents with loss of life or serious injury, near collisions or loss of control due to overload.

The sources of stress in ATC are Traffic density, air space complexity, jurisdiction under control, airspace restrictions and prohibition (restricted , prohibited and danger areas), no. of conflict points, Absence of required and uniform ATS procedures, reliability and availability of communication , navigation and surveillance equipments, bad weather condition , VVIP movements, Emergencies, odd working hours, working conditions, office environment, inadequate man power, inadequate relief, inadequate HR policies and practices,

However, the consequences of these stresses indicate that the demanding work of air traffic controllers may well be a risk factor in the long term in the development of stress-related symptoms, including headaches, chronic fatigue, heartburn, indigestion and chest pain, as well as such serious illnesses as hypertension, coronary heart disease, diabetes, peptic ulcers and psychoneurotic disorders.
II) STRESS ALLOWANCE AND ITS HISTORY:

- In 1994, National Airports Authority of India introduced the concept of Stress Allowance (Additional Allowance) after taking into account the high stress factor involved in managing the heavy traffic density airspace.
- Some airports were not considered while making assessment of stress based on actual traffic due to non-availability of data. In 1995, such airports were included in the list of airports provided with stress allowances.
- In 2006 revision, a comprehensive study was not made by CHQ for all stations. Without any criteria, stress allowances for only five airports were revised and two airports were included. Major stations like Mumbai and Delhi, where the traffic has gone up by almost four fold since 1997, have been ignored. Now situation is that the stress allowance for Mumbai and Delhi is same as that of Nagpur and Ahmedabad.
- A formula needs to be devised so that periodic review of traffic and other factors are considered and revision of stress allowance is made accordingly.
- Always stress allowance has been related to the basic rating allowances.

REFERENCES:

1) A-60011/40/94-PP DATED 14TH SEPTEMBER, 1994
2) A-60011/40/94-PP DATED 12-06-1995
3) A-60011/40/97-PP DATED 19TH NOV 1997
4) F.NO A6001/45/2004-99 DATED 27TH /30TH JAN 2006
5) ACTUAL TRAFFIC DATA OF IGI AIRPORT
A) On 1st JAN 1997 a controller was drawing rating allowances as per reference (1) above.

<table>
<thead>
<tr>
<th>UNIT</th>
<th>ALLOWANCE (per month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TWR/SMC</td>
<td>2000/-</td>
</tr>
<tr>
<td>ACC/FIC</td>
<td>2000/-</td>
</tr>
<tr>
<td>ASR/MSSR-APP</td>
<td>3000/-</td>
</tr>
<tr>
<td>ARSR/MSSR-ACC</td>
<td>2000/-</td>
</tr>
</tbody>
</table>

In addition to above at Kolkata and Chennai controllers were drawing ADS allowance of 1000/- and a controller not having any rating was drawing FDPS allowance of 1000/-

B) Stress Allowances reference (1) and (2) above:

The stress allowance was paid at the rate given below.

<table>
<thead>
<tr>
<th>STATION</th>
<th>STRESS ALLOWANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DELHI</td>
<td>50%</td>
</tr>
<tr>
<td>MUMBAI</td>
<td>50%</td>
</tr>
<tr>
<td>KOLKATA</td>
<td>50%-TWR, 50%- Other Units</td>
</tr>
<tr>
<td>CHENNAI</td>
<td>25%</td>
</tr>
<tr>
<td>NAGPUR</td>
<td>25%</td>
</tr>
<tr>
<td>AHEMDABAD</td>
<td>25%</td>
</tr>
<tr>
<td>TRIVENDRUM</td>
<td>25%</td>
</tr>
<tr>
<td>HYDERABAD</td>
<td>NIL</td>
</tr>
<tr>
<td>VARANASI</td>
<td>NIL</td>
</tr>
</tbody>
</table>

In 2006 the Stress allowances were reviewed by the AAI for certain stations (vide reference 4 above)) as detailed below.

<table>
<thead>
<tr>
<th>Name of the Airport Allowance</th>
<th>Revised Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delhi</td>
<td>50% (No change)</td>
</tr>
<tr>
<td>Mumbai</td>
<td>50% (No change)</td>
</tr>
<tr>
<td>Kolkata</td>
<td>50% (earlier 25%, 50%)</td>
</tr>
<tr>
<td>Chennai</td>
<td>50% (earlier 25%)</td>
</tr>
<tr>
<td>Nagpur</td>
<td>50% (earlier 25%)</td>
</tr>
<tr>
<td>Ahmadabad</td>
<td>50% (earlier 25%)</td>
</tr>
<tr>
<td>Trivandrum</td>
<td>25% (earlier 25%)</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>25% (Nil)</td>
</tr>
<tr>
<td>Varanasi</td>
<td>25% (Nil)</td>
</tr>
</tbody>
</table>
III) REQUIREMENT OF REVIEWING STRESS ALLOWANCES

(a) AS PER AAI LETTER F.NO A6001/45/2004-99
DATED 27TH /30TH JAN 2006
(PAGE NO 4)

"FOR CALCULATION OF STRESS ALLOWANCE
THE STRESS FACTOR HAS TO BE WORKED OUT
ON THE CRITERIA OF TRAFFIC DENSITY AND
SHOULD BE REVIEWED FROM TIME TO TIME "

But it appears that though the AAI has agreed for
above criterion for reviewing stress allowances but
could not implement it in the same letter properly.

(b) There was no increase in stress allowances at
most of the stations including Delhi and Mumbai.
Even at stations where the stress allowances
were marginally increased, they were not
commensurate with traffic increase at these
stations, whereas during these time air traffic
growth in India has proven to be at the
maximum.

(c) The proposal for stress allowance was mooted
by ATM Directorate in 2003 and could be
implemented only in 2006. There comparison of
traffic data in 2003 and 2008 justifies immediate
revision.

For the Criterion of calculating the traffic density the traffic operating
through the facility/airspace should be taken into account and it
should be inclusive of departure, arrival, over flying and local flying.

Similarly at some of the medium-low stations like Jaipur, Lucknow,
cochin amritsar, calicut, etc. a controller is providing Area, Approach,
Aerodrome, Surface movement control service, rescue and alerting
services, flight information services to an aircraft with PROCEDURAL
CONTROL (which calls for more separation between aircrafts leading to
more time an aircraft in contact with an ATC unit leading to increased
stress even with relatively less traffic).
Stations like Guwahati have not only witnessed increase in traffic but also complexity of airspace, dangerous terrain, coordination requirement with defence authorities, control/co-ordination of defence aircrafts etc. adds to the stress of an ATCO.

IV) PROPOSED STRESS ALLOWANCES:

A) NUMBER OF AVERAGE MOVEMENTS PER DAY IN 1997-98 = 269
   (Inclusive of over flying, local flying AT DELHI)

B) NUMBER OF AVERAGE MOVEMENTS PER DAY IN 2007-08 = 880
   (Inclusive of over flying, local flying AT DELHI)

THE INCREASE IN THE STRESS FACTOR FROM 1997-98 TO 2007-2008 IS

\[
\frac{\text{NUMBER OF AVERAGE MOVEMENTS PER DAY IN 2007-08} - \text{NUMBER OF AVERAGE MOVEMENTS PER DAY IN 1996-97}}{\text{NUMBER OF AVERAGE MOVEMENTS PER DAY IN 1996-97}} = \frac{880 - 269}{269} = 3.3
\]

THEREFORE AS AGREED IN 1997 THE STRESS ALLOWANCE AT THE STATIONS SHOULD BE A FUNCTION OF NUMBER OF AIRCRAFT HANDELED.

THE PROPOSAL FOR REVISED STRESS ALLOWANCE IS AS BELOW:
Besides other factors affecting the stress in ATC, NUMBER of aircrafts handled by the ATC station shall be the determining factor for assessment of stress.

<table>
<thead>
<tr>
<th>NO OF ACFT HANDLED</th>
<th>STRESS ALLOWANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 50</td>
<td>25%</td>
</tr>
<tr>
<td>51 to 150</td>
<td>35%</td>
</tr>
<tr>
<td>151 to 250</td>
<td>50%</td>
</tr>
</tbody>
</table>

Stress allowance to be increased by 5% for every increase of 25 movements above 250 movements and the same shall be reviewed every six months. Accordingly,

| 401 to 425          | 85%               |
| 601 to 625          | 125%              |
V) Stress allowances should be reviewed every 6 months viz on 30th September and 31st March of every year except for new airports like BIAL where other dates should be considered.

VI) Every Air Traffic Controller shall be allowed to undertake stress reducing courses like yoga, art of living reimbursable up to 25000/- and at least 10 days official off in a year. Air Traffic Controller shall be given membership of the health/sports club close to their residences to maintain their health as per the requirement of ICAO ANNEX 1.

VII) Since ATCOs are the only set of employees in Airports Authority of India who are required to undergo periodic medical assessment as per ICAO Annex I, a comprehensive Medical Policy shall be prepared for exclusively for them.