

# 二零零五年內地與香港 建築經濟房地產與城市防災研討會

西安·二零零五年九月二十日至廿二日

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西安·香港



# Air Duct Cleaning – Does It Help To Improve Ventilation Hygiene?

Mr. KL Chan  
President

Air Conditioning and Refrigeration  
Association of Hong Kong

Mr. CF Wong  
Founding Member

Hong Kong Building Commissioning Centre

Dr. Leonard Chow  
Chairman of Executive Committee  
Asian Institute of Intelligent Buildings

Mr. Philip Pih  
Immediate Past President  
Building Services Operation and Maintenance  
Executives Society

## Abstract

Heating, ventilating, and air-conditioning (HVAC) ductworks are used to convey conditioned air from air handling units to rooms or vice versa for polluted air. However, ductworks can be potential sources of dust and related microbial contamination such as mould due to air movement and favourable temperature and humidity environment, these would affect occupants' health and working efficiency. Due to increasingly demand on indoor air quality (IAQ), building professionals are considering different means to improve IAQ and duct cleaning is one of the ways to remedy indoor air quality problems. Air ductworks are usually contaminated during manufacturing, erection and operating stages. Proper design, installation and regular inspection and maintenance on air ductworks could help to reduce such health hazard. Air duct cleaning is basically a physical cleaning process on HVAC system and components. In this paper, overviews on different air duct cleaning practices and the recommendations on the necessity of air duct cleaning will be briefly described. Several cases in commercial premises in Hong Kong are also discussed.

## Keywords

Air ductworks, health and safety, mould, indoor air quality, cleaning practice

## 1. INTRODUCTION

Heating, ventilating, and air-conditioning system (HVAC) is one of the attributes in modern buildings. Central HVAC system inevitably makes use of air ducts which are typically a sealed system used to convey conditioned air from air handling units to occupied space or vice versa for polluted air. However, they can be potential sources of dust and related microbial contamination such as mould due to air movement and favourable temperature and humidity environment. Such dust and microbial would cause problems on indoor air quality (IAQ) leading to illness symptoms and working efficiency for those tenants and occupiers. Operation and maintenance (O&M) professionals are the only technical people within the building in post-acceptance stage, and they are responsible to the tenants and clients. In IAQ remediation, O&M people could consider duct cleaning as one of the ways to remedy the problems. Air duct cleaning is a physical cleaning process of HVAC system components including ducts, air terminals, heat exchangers (heating and cooling coils), condensate drains and pans, system filters, fan motors and air handling unit housings. The type of ductwork manufacturing, the way the ducts are fixed, the filtration system, and external contamination



all affect the condition of the ductwork. The key to prevent air duct related pollution problems is a combination of proper design, construction and regular inspection and maintenance. Operators who are considering having the ducts cleaned should first determine that contaminated ducts are the cause of problems. When the ducts are definitely to be cleaned, the dirtiness of ducts shall be scientifically assessed through single or combined physical, chemical and biological means.

## 2. IS AIR DUCT CLEANING REQUIRED?

Air duct is a product fabricated either in factory or on site directly from raw material usually galvanized steel sheet. This could be either by machine or by hand. During the fabrication process, inevitably the duct surfaces will be contaminated by grease, oil, dust and other visible or invisible materials and these substances leading to potential hazard on indoor air quality (IAQ) when they are commissioned to use.

### 2.1 Construction Requirements

Most of the general and technical specifications called for a clean HVAC system to be handed over before use. Unlike other HVAC components and products, air ductwork cannot be easily inspected and certified to appropriate cleanliness due to its shape, length and components built in. During the on site construction process, the air ducts would be fixed in position for quite a long time before hand over and the ducts are subject to accumulation of dirt and construction debris. In this consequence, air ducts should be inspected, cleaned if necessary in accordance with the contract and actual situation.

### 2.2 Health and Safety

Bioaerosols are airborne particles of biological origin. Due to favourable temperature and humidity (above 70% RH), fungi and molds even bacteria could grow easily along the air pathway then get into occupied spaces [3]. Dust accumulated in the ductworks can provide ample nutrients for microbes so air duct become an incubator and this is known as microbial contamination in HVAC system. A number of building related illness can be caused by bioaerosols. This including allergic reactions such as fever-like symptoms and asthma [3]. Air ducts might need cleaning to meet the respective safety and health legislation. In United Kingdom, the Health and Safety Work Act, Workplace (Health and Safety Welfare) Regulation states that employers and occupiers have the responsibility to maintain a healthy workplace for employees. Therefore, a clean working environment is required and a duty to clean "as appropriate". In United States, there are about 30 states and federal governments are proposing on mold legislation and 16 states have enacted such legislation [4]. In Hong Kong, there is no specific requirement on duct cleaning.

### 2.3 Management

The need to clean HVAC system in existing building is becoming popular and acknowledged by many prestigious building owners and occupiers. In order to meet some companies' policy in maintaining good practices in property management, operation and maintenance activities, HVAC system including air duct would be

cleaned. Under this category, inspection is a pre-requisite to actual duct cleaning process.

### **3. CONCERNS ON HEALTH AND SAFETY**

In building management, the occupants and occupiers' health and safety are preliminary concerns. Although there are no significant evidence to prove dirty air-conditioning installation would affect occupants' health and poor ventilation has not been sourced as the sole cause of Sick Building Syndrome but is in a majority of cases the largest contributing factor [5], [6]. This syndrome appears to be the most prevalent in buildings with recirculating ventilation or air conditioning systems.

The symptoms of this illness are eye irritation, stuffy or runny nose, throat irritation, skin irritation or rash, headaches, lethargy, irritability and lack of concentration. Any, or all of these might effect anyone at any time but when an incident occurs work patterns and attendance are affected. It is important that a sufficient supply of fresh air is made available as it is required for respiration, to dilute contaminates and to reduce odours, all of which are related to Sick Building Syndrome.

Due to favourable temperature and relative humidity inside the air ductworks, mould growth will exist and cause bad aesthetics and smell, possibly affecting the structural integrity of wood-frame buildings [8].

Poor indoor air quality as result of excessive carbon dioxide, ozone, airborne bacteria and respirable suspended particulates (RSP) are common in commercial premises [9]. Tiny airborne particles or aerosols that are less than 100 micrometers are collectively referred to as total suspended particulate matter (TSP). Nowadays,  $PM_{10}$  is commonly used as a measure on RSP. A clean indoor environment should be less than 1500 airborne bacteria and 100 RSP per cubic metre respectively [9].

### **4. CLEANING PRACTICE AND METHODOLOGY**

Air duct cleaning is not as simple as typical dust cleaning. Air duct cleaning involves a detailed planning and analysis from design, construction and maintenance stages. Requirements on cleaning could be well determined during design stage. Consequently, adequate cleaning access provisions would be provided along the ductwork. During construction, the traditional ductwork fabrication process, installation and fixing method would be reviewed so as the foreseeable contamination can be kept minimal. In maintenance, regular physical, chemical, even biological assessments on ductwork cleanliness shall be executed. Cleaning process is another important task. Failing to carry out good practices, it is possible that dust and dirt accumulated from the ductwork might be further proliferated into occupied spaces thus making the situation worse. The cost on air duct cleaning is still no data available but would be estimated in project based.

The worldwide cleaning practices and methodologies have been illustrated and discussed by the same authors in papers [1] and [2].

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- [9] 任道鳳、馬來紀、金錫鵬，*名醫談百病－空調病*，2001，南粵出版社（原：上海科學技術出版社）

## APPENDIX

(a) Fresh Air Fan Room (Mixing Plenum)



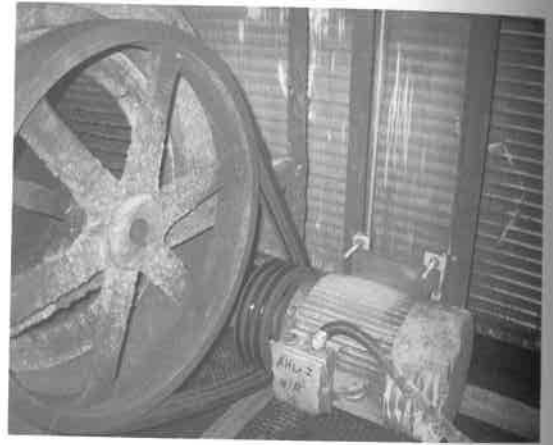
(b) Wall Lining



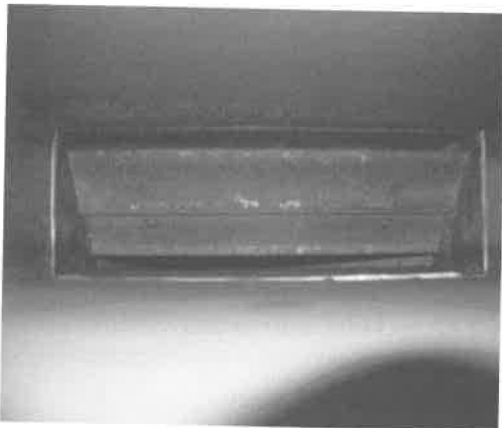
(c) Inside an Air Handling Unit



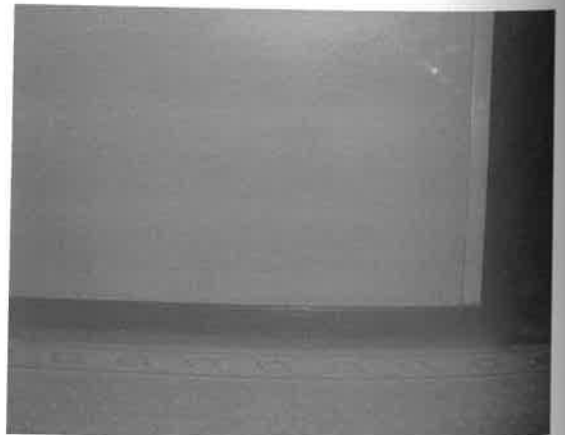
(d) Fan and Motors



(e) Supply Air Duct Damper



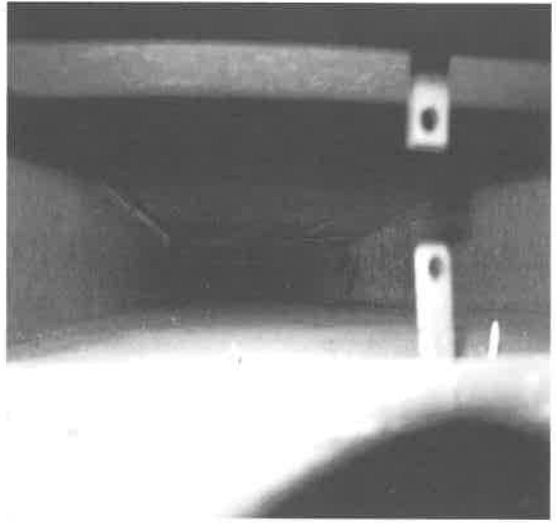
(f) Mould on Wall Paper – Corridor

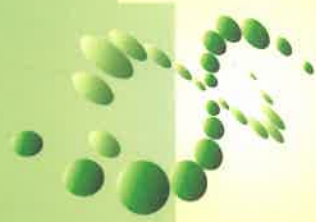


(g) Inside of a SAD



(h) Fresh Air Duct





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