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香港機電業工會聯合會
THE FEDERATION OF HONG KONG ELECTRICAL & MECHANICAL INDUSTRIES TRADE UNIONS

編者的話

○ 編輯小組

工會網頁的技術支援區近來愈見受到會員行家的歡迎，詢問工程的處理方法問題漸多，而查詢的技術深度亦見水平，證明通過答問的互動過程是提升我們行業的好方法。當中涉及接地電阻抗檢測或頗多問題都與工作守則有關，所以特地情商陳富濟老師及孫名林老師為大家介紹進行上述工作時需要留意的重點。

提高能源效益是近來大勢所趨，今期分別有機電工程署及鄧文熙老師為我們撰文論述。久違了的資深顧問王鎮輝亦在本期重出江湖，執筆寫了一篇極有份量的文章，提出一些最新的英國標準改動資料，看來對新的工作守則修改有極高的參考價值。

此外，還有部份查詢表示對空調系統的凍喉漏水和近日電死人的手機充電器結構產生興趣，故此我們邀請得李煒權老師及馮劍雲老師給我們解答上述疑難。至於陸瑋聰兄論述如何減少商廈噪音下篇的原文，續在今期刊出；惟因稿擠的緣故，下期才刊出其譯文。

今年是港九電器工程電業器材職工會（電職）建會55周年，五十五年是一段不短的時間，在香港具有如此悠久歷史的工會固然不多，而能夠在這麼長的時間仍然站穩在保障工友職業生活的前列更是難能可貴；他們無論是在協助工友註冊、推廣職業安全意識、釐定行業工資、舉辦持續進修講座，甚至協助本刊的面世…等都全力以赴，相信這正是他們能夠成功的原因。在此謹代表本刊仝寅，恭祝電職會務更趨昌盛，迎接60甲子的到來。

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強制性能源效益標籤計劃

機電工程署

為方便市民挑選具能源效益的產品及提升公眾對節約能源的意識，政府現正透過《能源效益（產品標籤）條例》（第 598 章）推行強制性能源效益標籤計劃，該計劃涵蓋五類訂明產品（冷氣機（空調機）、雪櫃（冷凍器具）、慳電膽（緊湊型熒光燈）、洗衣機及抽濕機）。在本港供應的訂明產品都必須附有能源標籤，讓消費者知悉有關產品的能源效益表現。

五類訂明產品必須附有能源標籤

根據條例規定，進口商或本地製造商在供應上述五類訂明產品之前，必須先向機電工程署呈交產品型號的資料（包括能源效益測試報告）。如所呈交的資料妥當，機電工程署會按進口商或本地製造商的名稱，為該產品型號編配參考編號，其後進口商或本地製造商才可把該型號的產品供應給本港市場，而供應的產品必須附有符合規定的能源標籤。如果是進口商或本地製造商以外的人（例如零售商或批發商）供應該五類訂明產品，也必須屬已獲編配參考編號的型號，並附有符合規定的能源標籤。任何人如違反條例的規定，即屬違法，一經定罪，可處最高罰款 $10 萬。機電工程署會加強巡查以執行有關法例。

能源效益分為五級

具能源效益的產品不但消耗較少能源，亦有助保護環境，長遠來說更可幫助消費者節省金錢。能源標籤把同一類產品的能源效益分為五級，方便消費者選擇具能源效益的產品。獲得第一級能源標籤的產品，表示該產品的能源效益最高。以第一級比第三級及第五級，分別可節省的耗電量大約如下：

節約能源百分比

訂明產品類別	第一級比第三級	第一級比第五級
冷氣機（空調機）	節省15%	節省 29%
雪櫃（冷凍器具）	節省 35%	節省 49%
慳電膽（緊湊型熒光燈）	節省 14%	節省 18%
洗衣機（包括洗衣乾衣機）	節省 25%	節省 40%
壓縮式抽濕機	節省 24%	節省 42%

以一部貼有「第一級」能源標籤、製冷量約 2.6千瓦(kW) 的「一匹」冷氣機與相同製冷量而附「第五級」能源標籤的冷氣機相比，假設每年運作 1,200 小時及電費平均為每

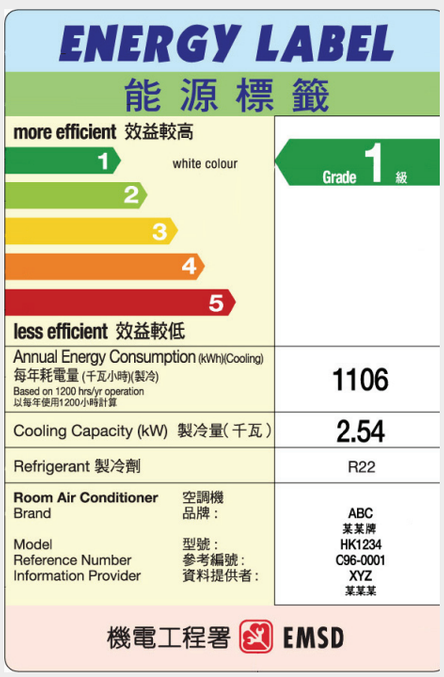
度電 $1，附「第一級」能源標籤的冷氣機每年可節省大約 $480 電費。

以一部貼有「第一級」能源標籤而洗衣量為 5 公斤的水平滾筒式洗衣機(俗稱「歐洲式」洗衣機)為例，與另一部相同洗衣量而附「第五級」能源標籤的同類洗衣機相比，假設每年使用 260 次及電費平均為每度電$1，附「第一級」能源標籤的型號每年可節省約 $170 的電費。

能源標籤網

要認識能源標籤，最好方法是登入機電工程署的能源標籤網（http：//www.energylabel.emsd.gov.hk），裡面有大家要知道的一切有關能源標籤和有關法例的詳情，還有常見問題的答案等。

業界也可於該網站下載「產品能源標籤實務守則」，掌握能源標籤的技術細則，或報名參加由機電工程署定期舉辦的簡介會，了解強制性能源效益標籤計劃的詳情。另外，網站還有已獲編配參考編號並附有能源標籤的表列型號的產品列表和能源計算機等有用資訊，供消費者參考。



查　詢

如欲得知有關強制性能源效益標籤計劃的詳細資料，除可瀏覽能源標籤網外，亦可致電 2808 3465 機電工程署能源效益事務處查詢。

英國標準的改動與【電力（線路）規例工作守則】

王鎮輝

老嘢出名以老賣老，支筆擱置多年，業界耳根清靜。今次友情復出，少不免又再發嘮嚟。一如過往，文中有些地方挖苦機電署，見諒見諒！

本文內容純屬老嘢個人意見，並不代表工會立場。

香港雖然回歸祖國十多年，但因受英國統治了近一百年，有些地方是不容易脫離英國影響，例如最普及的插頭和插座，是用唯有英國、英屬及曾受其治理的地方所採用的方形設計。就算政府機電工程署製作的【電力（線路）規例工作守則】內容也不能全部以國際電工技術委員會標準取代英國標準。

自從【電力（線路）規例工作守則】在 2009 年修訂後，這幾年來有數條守則內引用的英國標準也有更新或改動。其中對電工影響較大的英國標準，筆者在以下介紹予大家。

高分斷能力的熔斷器（HRC Fuses）

高分斷能力熔斷器的國際標準是 IEC 60269 系列，其中以下列兩部分較普及：

- IEC 60269-2：2010：專職人員使用的熔斷器的補充要求（主要用於工業的熔斷器）標準化熔斷器系統示例 A 至 I 標準
- IEC 60269-3：2013：非熟練人員使用的熔斷器的補充要求（主要用於家用和類似用途的熔斷器）標準化熔斷器系統示例 A 至 F 標準

香港電工較為熟識的高分斷能力熔斷器是英國標準 88 系列，與 IEC 對應的部分是 BS 88-2：2010 及 BS 88-3：2010。這些標準反映了 IEC60269 系列和 CENELEC EN 60269 系列低壓熔斷器標準的發展，但範圍只包括 IEC 60269 內有關英國採用的熔斷器。這兩個標準部分與目前【電力（線路）規例工作守則】有關高分斷能力熔斷器的內容，主要變化有：

1. BS 88-2.2（螺栓式熔斷器）被 BS 88-2（熔斷器系統 E）取代。

2. BS 88-6（夾緊式熔斷器）被 BS 88-2（熔斷器系統 G）取代。
3. BS 1361（圓管式熔斷器）被 BS 88-3（熔斷器系統 C）取代。

上述變化對電力裝置設計的影響有二：

1. 新標準的熔斷器的時間－電流特性與舊標準有別。
2. BS 88-3 的熔斷器有部分額定值與 BS 1361 不同。

因此 2009 年版【電力（線路）規例工作守則】表 11(3) 和 11(4) 有關保護導體尺寸，及表 11(8)、11(9)、11(11) 和 11(12) 有關接地故障環路阻抗的數據有部分將會調整（見表 1 和表 2）。

表 1：當電路以符合 BS 88-2 熔斷器保護而標稱電壓為 220V 時的最大接地故障環路阻抗

熔斷器額定值（A）												
6	10	16	20	25	32	40	50	63	80	100	125	160
在 0.4 秒內切斷電源的最大接地故障環路阻抗（Ω）												
7.9	4.7	2.5	1.7	1.3	1							
在 5 秒內切斷電源的最大接地故障環路阻抗（Ω）												
12.2	6.9	4	2.8	2.2	1.8	1.3	1	0.8	0.55	0.44	0.32	0.26

表 2：當電路以符合 BS 88-3 熔斷器保護而標稱電壓為 220V 時的最大接地故障環路阻抗

熔斷器額定值（A）							
5	16	20	32	45	63	80	100
在 0.4 秒內切斷電源的最大接地故障環路阻抗（Ω）							
10	2.32	1.95	0.92				
在 5 秒內切斷電源的最大接地故障環路阻抗（Ω）							
14.66	3.93	3.23	1.57	0.99	0.69	0.5	0.38

此外，歐洲其它國家製造的熔斷器亦為香港電工採用，其中以根據德國標準（Deutsches Institut für Normung，簡稱 DIN）製造的 NF 熔斷器較普及，但很多電工卻忽略了這些熔斷器的時間－電流特性與 BS 88 熔斷器不同，所以【電力（線路）規例工作守則】有關 BS 88 的數據並非完全適用於這類熔斷器。

熔斷器系統 G（夾緊式熔斷器）

熔斷器系統 E（螺栓式熔斷器）

熔斷器系統 C（圓管式熔斷器）

熔斷器系統 A（NF 熔斷器）

圖 1　香港常用的低壓熔斷器

聚氯乙烯絕緣裝甲電纜

聚氯乙烯絕緣裝甲電纜的英國標準是 BS 6346。這種電纜曾經非常普及，雖然交聯聚乙烯絕緣電纜有很多地方較聚乙氯烯絕緣電纜優勝，但因價格較貴，未能取代。

但時移易勢，隨著交聯聚乙烯絕緣電纜的價格下降，聚氯乙烯絕緣電纜的應用已漸趨減少，尤以聚氯乙烯絕緣裝甲電纜，在英國已被交聯聚乙烯絕緣電纜取代。BS 6346 在 2011 年被撤回，英國電纜製造商也不再生產這種電纜。在香港，BS 6346 電纜廣為電工熟識，亦可從非英國的電纜生產商購入。筆者相信，由於電工的慣性，聚氯乙烯絕緣裝甲電纜的應用仍會維持一段時間，但若電力裝置由顧問工程師設計，多會採用交聯聚乙烯絕緣電纜。

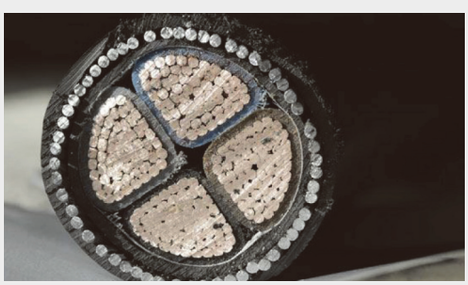


圖 2　BS 6346 聚氯乙烯絕緣裝甲電纜

電工應多些認識交聯聚乙烯絕緣電纜的特性，例如其優點是載流量較高及燃燒時釋放較小腐蝕性氣體，但若與聚氯乙烯絕緣電纜一起放置時，因前者可抵受較高表面溫度，應避免後者產生過熱。

聚氯乙烯絕緣無護套電纜

聚氯乙烯絕緣無護套電纜是電力裝置最常用的電纜，一般的敷設方法是放在導管或線槽內。在 2012 年前這種電纜的英國標準是 BS 6004 和 BS 6007，但因應歐洲一體化，聚氯乙烯絕緣無護套電纜的英國標準改為 BS EN 50525。除英國標準號碼和英國電纜製造商協會（CMA）電纜代碼更改外，其它技術要求保持不變。

表 3：BS 6004 改為 BS EN 50525 的電纜代碼改變

電纜種類	英國 CMA 電纜代碼	CENELEC 電纜代碼
聚氯乙烯絕緣無護套一般用途電纜，450/750V，單芯	6491X	H07V-U（實心導體） H07V-R（絞合導體） H07V-K（軟導體）

電纜種類	英國 CMA 電纜代碼	CENELEC 電纜代碼
聚氯乙烯絕緣無護套室內用途耐熱電纜，450/750V，單芯	6491X HR	H07V2-U（實心導體） H07V2-R（絞合導體） H07V2-K（軟導體）
聚氯乙烯絕緣無護套一般用途電纜，300/500V，單芯及雙芯絞合	2491X	H05V-U（實心導體） H05V-R（絞合導體） H05V-K（軟導體）
聚氯乙烯絕緣無護套室內用途耐熱電纜，300/500V，單芯及雙芯絞合	2491X HR	H05V2-U（實心導體） H05V2-R（絞合導體） H05V2-K（軟導體）

掣櫃及配電箱

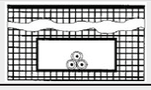
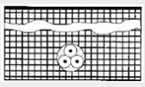
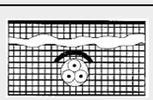
過往電工熟識的掣櫃及配電箱標準是 BS EN60439。當談及掣櫃有沒有「削」（certificate），皆指根據這標準試驗合格的証明書。BS EN 60439-1 已在 2009 年被 EN 61439-1 取代，有效期將於 2004 年 11 月 1 日正式終止。

對於大多數電工來說，這改變影響不大，因現今香港採用的掣櫃及配電箱多為「有牌」製造商的產品，但需注意明年開始不要購入舊有的「倉底貨」。

圖 3　掣櫃標準改變

電纜的載流量

2009 年版【電力（線路）規例工作守則】的出版日期是在 BS 7671：2008（英國 IEE 佈線規例十七版）一年多之後，但廣被電工參考的附錄 6（電纜載流量）及附錄 7（電纜敷設方法）卻未跟隨修改。

Installation Method			Reference Method to be used to determine current-carrying capacity
Number	Examples	Description	
70		Multicore unarmoured cable in conduit or in cable ducting in the ground	D
71		Single-core unarmoured cable in conduit or in cable ducting in the ground	D
72		Sheathed, armoured or multicore cables direct in the ground： - without added mechanical protection (see note)	D
73		Sheathed, armoured or multicore cables direct in the ground： with added mechanical protection (e.g. cable covers) (see note)	D

NOTE： The inclusion of directly hurried cables is satisfactory where the sill theraol reeierivity ie of the order of 3.5 K m/W For love

圖 4　埋地電纜計算載流量的參考方法

電工朋友可能會質疑筆者為何【電力（線路）規例工作守則】要跟隨「英國佬」修改，但豈不知第一版【電力（線路）規例工作守則】的內容絕大部分是 IEE 佈線規例的「仔」，而經過多次修訂，仍不能脫離其影響。況且 IEE 佈線規例十七版有關電纜載流量和敷設方法乃與 IEC 60364 共識，即「國際化」，但 2009 年版【電力（線路）

規例工作守則】卻仍逗留在十年前的「英國化」！

IEE 佈線規例十七版內電纜載流量和敷設方法與前版有顯著改變，例如敷設方法更細緻，及加插了埋地電纜的載流量。對於後者，IEE 佈線規例十七版在 2011 年的第一次修訂版更增加詳細的資料。

若電工需要敷設埋地電纜，或裝設一般電纜後被「抽秤」不足「安」，不妨參考 IEE 佈線規例十七版第一次修訂足本，可能有意外收獲！

BS 196 工業用保護型不能倒置插頭和插座

BS 196 於 2009 年 7 月 1 日被撤回。該產品已被 BS EN 60309-2（或 IEC 60309-2）設有鎖扣器件的工業用插座取代。後者的帽蓋扣環設計較前者的「滑動接地」觸頭被認為較可靠。筆者預期下一版【電力（線路）規例工作守則】會取消引用 BS 196。

圖 5　Reyrolle BS 196 插頭和插座

插座電路可否不用 RCD 保護？

這問題曾經有很多電工提出，亦不少香港電力裝置的插座電路沒有 RCD 保護亦為電力公司及機電署接受，但在什麼情況下才可作豁免卻沒有記載。

圖 6　無 RCD 保護的插座要有警告標誌

早在 2005 年，IEC 60364-4-41 第 411.3.3 項已清楚記載插座電路豁免 RCD 保護的條件：

1. 在熟練或指導的人監督下使用的插座，例如，在一些商業或工業地點；或
2. 一個接至特定設備的個別插座，例如供電予電腦伺伏器。

對第二項條件，IEE 佈線規例十七版還要求該插座有特別標誌或識別。

那麼，機電署究竟有什麼條件才可豁免呢？為何不清楚寫明？

輔助等電位接駁

這又是一個老套問題！曾幾何時，每年在機電署的研討會上都有電工提出疑問，究竟什麼要接駁，什麼不用接駁？最終大家的共識（機電署沒有明確的答案）是：「有懷疑就接了罷」。其實背後的原因是：「接了就立刻有電，唔接就要多重書面解釋，幾個星期後才可能有電」。

【電力（線路）規例工作守則】11F 有關輔助等電

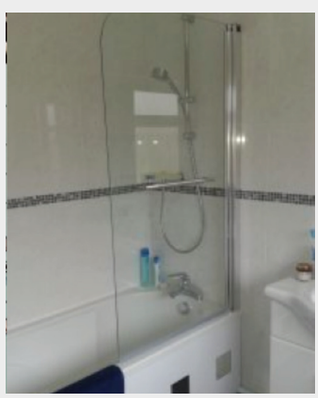


圖 7　根據工作守則 26A(3)(b)，浴室裝置若符合某些條件，可豁免裝設輔助等電位接駁導體，但為何其它危險性潛在較小的位置不可以呢？

位接駁的要求是出自 1981 年版 IEE 佈線規例第十五版。在 IEE 佈線規例第十六版開始，對輔助等電位接駁的概念已有改變，其後更把此接駁視作非必要時不需採用。大家請勿誤會「英國佬」又「玩嘢」，它只是「隨波逐流」，跟國際標準的大隊吧。

筆者的疑問是：為何機電署要「雞立鶴群」，還逗留在 1981 年的概念呢？

防雷系統的爭論

在 2009 年第 17 期的【今日機電】筆者曾經指出自稱效率奇佳的「流注提前發射防雷裝置」未為國際機構認同，亦不等效 IEC 60305。【電力（線路）規例工作守則】列出數種認可的防雷標準：

1. 國際標準 IEC 62305；
2. 英國標準 BS EN 62305；
3. 澳洲／紐西蘭標準 AS/NS 1768；
4. 美國標準 NFPA 780；
5. 其它等效標準。

因此，正確來說，符合法國 NFC 17-102 並不等效第 1 至 4 項標準。

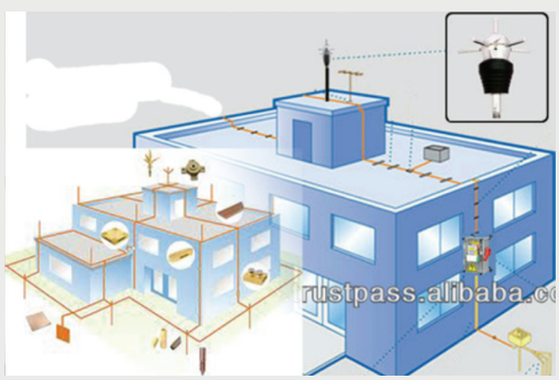


圖 8　流注提前發射防雷裝置（背景）與傳統防雷裝置（左下角）的比較：前者聲稱保護範圍較大及用料較少

四年後的今天，這情況仍沒有改變，包括 IEC 及 CENELEC 仍未認可 NFC 17-102、機電署毋視 NFC 17-102 的認可問題，沒有否定「流注提前發射防雷裝置」的使用、香港的建築物繼續暴露在這潛在的危險等等！

電工們，你們裝備好嗎？

現有的【電力（線路）規例工作守則】在 2009 年出版，較 IEE 佈線規例第十七版後了一年，但後者有些內容雖然值得參考，但並未被【工作守則】引用。IEE 佈線規例第十七版在 2010 年作出重要修訂，筆者覺得是否會被明年出版【電力（線路）規例工作守則】引用並不重要，重要的是電工們應好好裝備自己，以應付日新月異的電氣產品及技術。例如：

- 電壓及電磁的騷擾（IEC 60364-4-44）；
- 過電壓保護和電湧保護器的應用（IEC 60364-5-53）；
- 醫療場所（包括一般診所）的電力裝置要求（IEC 60364-7-710）；
- 掣房的開關和控掣設備的操作和維修（IEC 60364-7-729）。

後　言

筆者不要求工友們充份了解本文各點，但若有疑問，可知工會有一百多名註冊電業工程人員持續進修訓練導師，不少課程及講座，是進修的一個好地方！

接地極和接地極電阻

陳富濟
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不少電力裝置工程的從業員，在處理接地極的裝設（俗稱：打銅棍）時，都會出現以下的問題：接地極電阻的大小有沒有規定？如果有，又不可超過多大？

一、 問題的探討

在討論接地極電阻的大小有沒有規定之前，首先以其在裝置中的用途，來進行接地極的分類，再以不同的用途類別來探討相關的規定。

1.1 電力裝置保護接地的接地極電阻

a. 在現行的一

- ＊《電力（線路）規例工作守則》（下稱：《守則》）
- ＊《IEC 60364 Electrical Installations for Buildings（國際電工技術委員會・建築物電氣裝置）》
- ＊《BS7671 Requirements for electrical installations（英國標準 7671 電力裝置規例）》和
- ＊《中國國家標準˙GB 16895 建築物電氣裝置》

這些在《守則》中列為「署長所認可的標準」，都沒有明確指出作為電力裝置保護接地用途的規定數值。

b. 內地《中華人民共和國行業標準˙JGJ16—2008 民用建築電氣設計規範》12.4.3（2）指出：「低壓電纜和架空線路在引入建築物處，對於 TN-S 或TN—C-S 系統，保護導體（PE）或保護接地中性導體（PEN）應重複接地，接地電阻不宜超過10Ω；對於TT系統，保護導體（PE）單獨接地，接地電阻不宜超過 4Ω」。

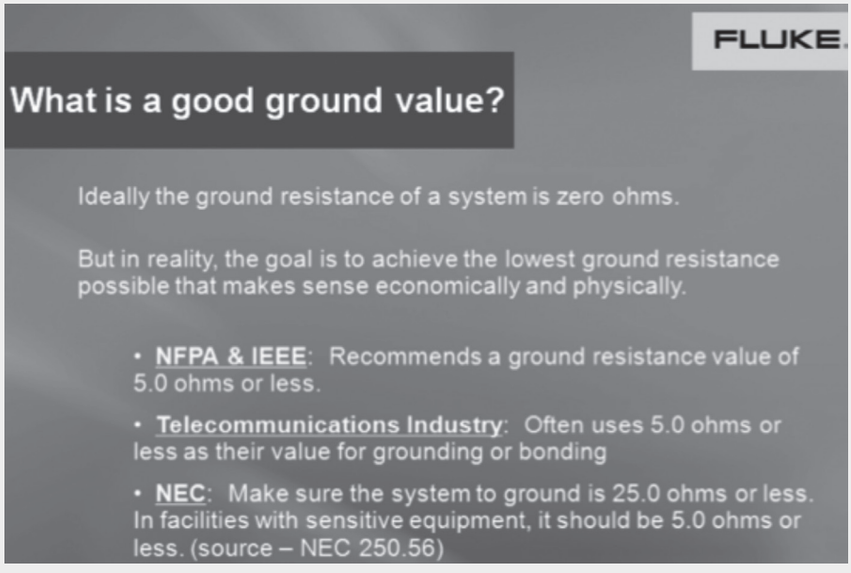
在香港，TN-S 系統用於自備發電機的裝置，TT 系統用於由供電商供電的裝置。

中華人民共和國行業標準是中華人民共和國在沒有國家標準而又需要在全國某個行業範圍內統一技術要求的情況下而制定的標準。行業標準由國務院有關行政主管部門制定，並報國務院標準化行政主管部門備案，在公布國家標準之後，該項行業標準即行廢止。行業標準和國家標準一樣，分為強制性標準和推薦性標準。保障人體健康，人身、財產安全的標準和法律、行政法規規定強制執行的標準是強制性標準，其他標準是推薦性標準。

c. 美國標準：NFPA（National Fire Protection Association，美國消防協會） 推薦：不超過5Ω；NEC（National Electrical Code，美國國家電氣規範）：一般裝置不超過25Ω，特別裝置不超過 5Ω。（引述自 FLUKE 儀表資料，見圖 1）

d. 香港的工程章程：在一些傳統（用了多年）的工程章程中，要求電力裝置保護接地的接地極電阻必須小於 1Ω。（見圖2）

圖一



圖二

EARTHING - EARTH ROD

a) The earth electrode shall be of mild steel inner core with bonded hard drawn copper sleeve.
b) The diameter of steel core shall not be less than 16 mm with the sleeve of at least 2 mm thick. Each electrode shall be at least 2.4 m long. The penetrating end of the electrode shall be made of hardened steel.
c) The portion of the tape connecting the pressure clamp to the test clamp shall be 600 mm below ground level or as shown in the drawings.
d) Earth mat comprising a number of earth rod as specified shall be provided as shown on the drawings. They shall be connected together by copper tapes of 50 mm x 6 mm cross-section buried 600 mm underground so that the overall earth resistance shall be less than 1 ohm for Electrical System and HKE's Equipment, less than 3 ohm for Generator System and Telecommunication System, and less than 10 ohm for lightning protection system.

1.2 避雷系統的接地極電阻

《守則》規定：「截斷與總接地端的連接後，所量度得的接地終端網絡電阻不超過10歐姆」。（《守則・核對表 4》）注意《守則》中指出的是「接地終端網絡電阻（Earth Termination Network Resistance）」，而不是「接地極電阻」。

1.3 其他系統的接地極電阻

這包括：電訊系統、電腦系統等等。其接地極電阻，大多是以符合相關的特定要求。

二、問題的思考

根據各類不同用途的接地極電阻要求，我們也許會產生下列的思考：

2.1 接地極的電阻，受到那些因素影響？有什麼方法可以減少地阻？

2.2 接地極電阻小於 1Ω，是不是不難做到？如果是，那為什麼避雷接地終端網絡（注意：不是「接地極電阻」）卻需要定在不超過 10Ω這麼高的數值？如果不是，那為什麼長久以來，在行業都不認為存有問題，不少的建築物都可以達到工程章程的「要求」？

在這裡，先討論 2.1 有關影響接地極電阻的因素，同時為了簡化討論，採取行業中最常用的接地極施工方式 ——「打入或直埋單根銅棍」。

接地極電阻（R）的計算公式是：

$$R = \frac{\rho}{2\pi L}\left(1n\frac{8L}{d} - 1\right) \qquad （公式 1）$$

公式1中的 ρ 是大地土壤（假設是均勻分佈）的電阻率（Ω-m），L 是接地棒或銅管埋入土壤的深度（m），d 是接地棒或銅管的外圍直徑（m）。

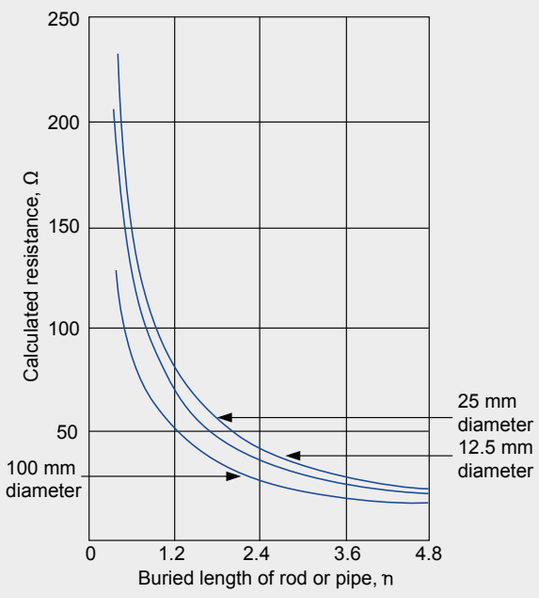
從這公式可以看到：

* 能夠選擇到土壤電阻率較小的地點埋入接地極，對接地極電阻是起著決定性的影響，但在香港的樓宇裝置工程，在極

大的條件和現實情況下，這是一個可以說是無法可以有所選擇的因素。表1是摘錄自《GB/T50065-2011 交流電氣裝置的接地設計規範》。

* 加大接地極埋入土壤的深度（L），會對接地極電阻有所改善，但不是非常直接有效，因為在數式的前半部 L 是分母，而在數式的後半部L是分子。
  - ➢ 因此，在一定的埋入深度情況下，有著「每把接地極的埋入深度增加 1 倍，接地極電阻降低 40%」的工程估算。圖3是摘錄自英國Electrical Contractors' Association 出版，Darrell Locke著作的《Guide to the Wiring Regulations 17th Edition IEE Wiring Regulations（BS 7671： 2008）》。
  - ➢ 同時，在一般工程的認識和習慣上都認為，當接地極埋入土壤的深度達到2.4m，再加大埋入深度，也不會對接地極電阻有很大的改善。但是，近年來經過研究人員的探索和試驗，提出「深埋（井）接地極」的裝置方式，圖4 是摘錄自互聯网的資料。（Martin D. Conroy 和 Paul G. Richard合撰的《DEEP EARTH GROUNDING VERSUS SHALLOW EARTH GROUNDING》http：//www.groundperfect.com/DeepEarthPaper.htm#basic_grounding）。
  - ➢ 我也曾在珠江出海口的沖積土地帶，打入接近 12m 的單枝包銅地極，取得滿意的地阻值。

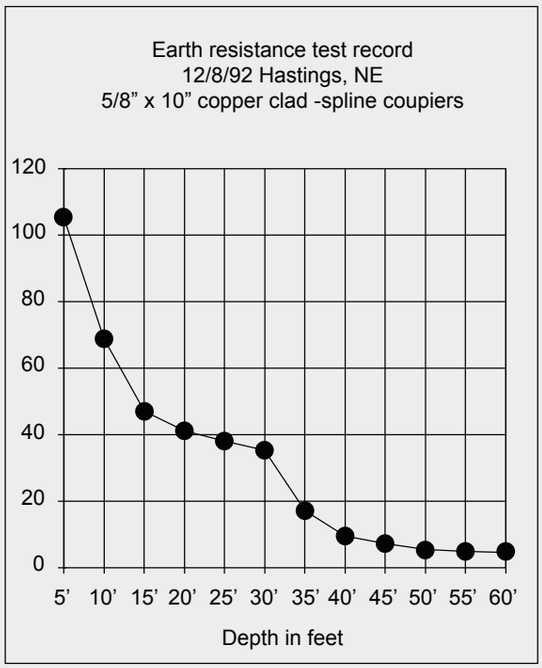
圖三



表一 土壤和水的電阻率參考值

類別	名稱	電阻率近似值(Ω·m)	不同情況下電阻率的變化範圍		
			較濕時(一般地區、多雨區)	較乾時(一般地區、沙漠區)	地下水含鹽碱時
土	陶黏土	10	5～20	10～100	3～10
	泥炭、泥灰岩、沼澤地	20	10～30	50～300	3～30
	搗碎的木炭	40	—	—	—
	黑土、園田土、陶土	50	30～100	50～300	10～30
	白堊土、黏土	60			
	砂質黏土	100	30～100	50～300	10～30
	黃土	200	l00～200	250	30
	含砂黏土、砂土	300	100～1000	1000以上	30～100
	河灘中的砂	—	300	—	—
	煤	—	350	—	—
	多石土壤	400	—	—	—
	上層紅色風化黏土、下層紅色頁岩	500(30％濕度)	—	—	—
	表層土夾石、下層礫石	600(15％濕度)	—	—	—
岩石	礫石、碎石	5000	—	—	—
	多岩山地	5000	—	—	—
	花崗岩	200000	—	—	—
混凝土	在水中	40～55	—	—	—
	在濕土中	100～200	—	—	—
	在乾土中	500～1300	—	—	—
	在乾燥的大氣中	12000～18000	—	—	—
礦	金屬礦石	0.01～1	—	—	—
砂	砂、砂礫	1000	25～1000	1000～2500	—
	砂層深度大於10m	1000	—	—	—
	地下水較深的草原				
	地面黏土深度不大於				
	1.5m 、底層多岩石				

圖四



✻ 從公式1和圖3看到，增加大接地極的直徑，可以降低接地極的電阻。從工程施工的角度來說，增加大接地極的直徑，是會大大增加成本和施工難度。但是這畢竟是一個可以降低地阻的方法，因此基於這理論，便發展了使用「降阻劑」進行降阻的方法。

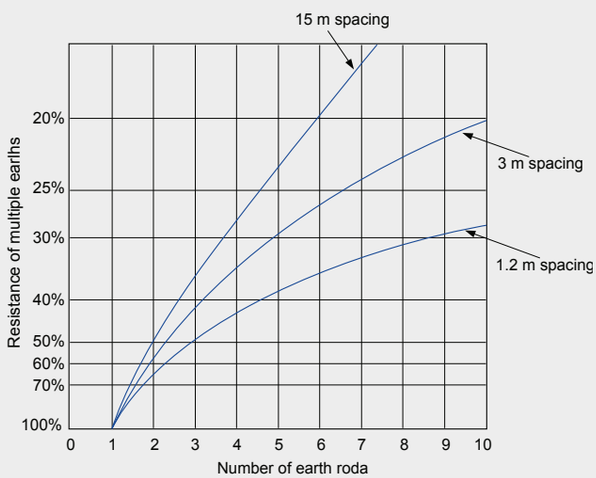
➢ 在接地極周圍敷設降阻劑後，一方面可以起到增大接地體幾何尺寸，降低與周圍大地介質之間的接觸電阻的作用。另一方面，降阻劑成份中含有強電解質物質，也可以改善土壤電阻率，因而能夠降低接地電阻。

➢ 根據网上資料，內地多採用鑽探機鑽出深井來增加接地極的埋入深度，並在深井中接地極的周圍填入降阻劑，來有效加大了接地體的幾何直徑。同時也有機會利用到電阻率較低的深層土壤。

✻ 裝設多根接地極，並且相互聯結。撇開實際的裝設環境是否許可的考慮外，這是一種長期以來業界各方面、各層面從業員都推薦的方式。

在裝設時，接地極的並聯地阻估算和相互的距離都是值得注意的。圖4也是摘錄自英國Electrical Contractors' Association 出版，Darrell Locke著作的《Guide to the Wiring Regulations 17th Edition IEE Wiring Regulations（BS 7671： 2008）》

圖五



✻ 更改接地極樣式。《守則12C（1）》載錄了接地極的類別：

（i） 接地棒或喉管；

（ii） 接地帶或線；

（iii）接地板；

（iv）鋼筋混凝土，包括板樁。

➢ GB16895.3- 2004《建築物電氣裝置第 5 部分：電氣設備的選擇和安裝第 54 章》（等同採用 IEC6 0364-5-54：2002《建築物電氣裝置第 5-54 部分：電氣設備的選擇和安裝

接地配置、保護導體和保護聯結導體》）中的 542.2.3 節指出，可採用的接地極舉例如下：

（I） 嵌入地基的地下金屬結構網（基礎接地）；
（II）金屬板；
（III）埋在地下混凝土（預應力混凝土除外）中的鋼筋；
（IV）金屬棒或管子；
（V） 金屬帶或線；
（VI）根據當地條件或要求所設電纜的金屬護套和其他金屬護層；
（VII）根據當地條件或要求所設置的其他適用的地下金屬網。

➢ 中國建築工業出版社出版的《基礎接地體及其應用》一書指出，鋼筋混凝土在其乾燥時，是不良導體，電阻率較大，但當具有一定濕度時，就成了較好的導電物質，電阻率常可達 100～200Ω-m。潮濕的混凝土導電性能較好，是因為混凝土中的矽酸鹽與水形成導電性鹽基性溶液。混凝土在施工過程中加入了較多的水分，成形後結構中密佈著很多大大小小的毛細孔洞，因此就有了一些水份儲存。當埋人地下後，地下的潮氣，又可通過毛細管作用吸人混凝土中，保持一定濕度。混凝土的含水量約在 3.5% 及以上時其電阻率就趨於穩定，當小於 3.5% 時電阻率便會隨水分的減小而增大。

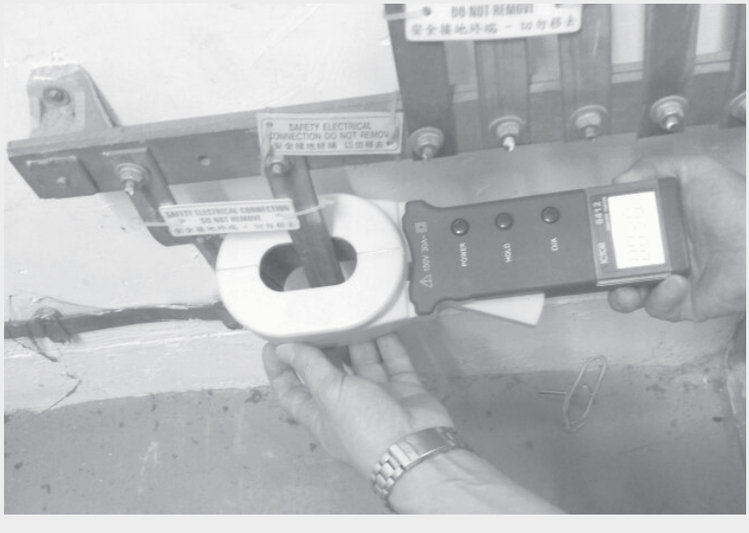
➢ 因此，根據上述的（iv）和（III）兩項，以及表 1 的資料，都說明使用建築物混凝土地基中的鋼筋作為接地極，是一種可行的方式。

三、 總結

各位讀者在閱讀了以上的討論內容後，相信都會得出：

* 如果用一般的「打銅棍」方式作為接地極，在樓宇的裝置工程，需要達到地阻小於 1Ω的「規定」，確實是不容易做得到。但卻不是一定不可以做得到，因為這可以投入大量的資金和人力來達成；
* 但如果改為使用建築物混凝土地基中的鋼筋作為接地極，達到地阻小於1Ω的「規定」，是可以做得到的。但這也需要行業上的設計思路改變，明確地接受這種方式。

因此，思考問題的 2.2 中的部份答案，留給各位讀者去尋找了。



低壓裝置初檢及年檢

香港機電專業學校課程策劃及技術總監 孫名林

近日工會的 whatsapp 技術討論專區,曾出現詢問做完插座工程後發現不明原因的故障；及查詢年檢的工作範圍。基於電力工程人員註冊制度及工作守則已面世二十多年，理應大部份同業對上述的問題的基本觀念非常清楚，但再想深一層，每年都有不少年青人入行，這類生力軍甚麼可能都理解其義，所以工會才不停主辦技能提升；持續進修的講座及課程，使行家們能快速地溫故知新，特別是當守則改版後，這是工會責無旁貸的工作。現再次將工程后的完工測試（初檢）及年檢概念向大家列出，使行家們精益求精，技術特飛猛進。

初檢（完工測試）：

工程設計者對樓宇電力設備的設計数據，全都是根據設備生產商提供的數據作估計或以工作守則的有關數据表內的最大值（如接地故障環路阻抗；電壓降等）或最小值（保護導體截面積）作依據，與實際的最終数值是不可能一樣。所以在交付给裝置擁有人使用前必須作完工測試，以檢查裝置是否符合設計者的安裝要求，並核實有關数據是否合符工作守則要求，使保護裝置在出現故障時，切斷電源等安全保護功能可以正常操作。 同時檢查在工程安裝時有否留下隱患，如供電電纜絕緣破損；電力裝置金屬外殼（外露非帶電金屬部份，外露導電部份（國內稱呼），Exposed Conductive Part）有否與帶電部份接觸等，以致出現漏電引起火警及人畜傷亡。

若對現有裝置進行改裝及加建，所謂 A&A（Addition and Alternation）工程，特別是對已檢驗合格的裝置，都必需對被改動及加裝部份進行撿查及驗正它們是處於安全狀態，同時並沒有降低原裝置的安全水平。如上述插座加建工程有作完工測試，便肯定在供電前找出安裝錯誤，不會引致供電後被投訴才發現有問題。

檢驗完畢後應編寫報告，若不合格當然須要修復工作，修復完成後須重做檢驗，報告須存檔備案，以便日後若出現問題時跟進。

年檢（定期檢查）：

已安裝的建築物電力裝置必須作周期性檢測，以判斷該裝置在使用一段時間後是否仍符合工作守則規定，會否劣化到不安全狀態及無法令保護裝置正常運作，同時監察現存裝置有否被胡亂改裝及加建的部份，檢驗完畢後應編寫第一份報告，其內容除測試結果數據外，當然還應對有關不合格的裝置進行修復工作，修復完成後須重做檢驗，若再次測試符合工作守則要求，年檢工作才算完成。

年檢完畢後須編寫完整報告，其內容除測試結果數據外，還應對有關曾修改部份作報告，並須交機電工程署署長加簽及存檔備案，以便日後若出現問題時跟進。

工作守則每項檢測的基本要求：

守則 21A 低壓電力裝置的檢查

應進行目視檢查，以證實所安裝的電力器具是否正確選擇並按照線路規例以及本守則的規定裝設，而且沒有明顯的損壞。目視檢查應按適當情況包括下列項目的檢驗:

註：括號內為工作守則的相應參考資料，但不是唯一，各同業應自行判斷有否其他守則或規定須要加入檢查，如電力裝置中涉及消防規例，又或有遺漏的工作守則需要遵守。

(a) 工作空間、接觸途徑及維修設施是否足夠；（是否符合守則 4E 的要求）
(b) 導體的連接；（是否符合守則 13C；25D 的要求）
(c) 導體的識別；（是否符合守則 13D (2) 及17F 等的要求）
(d) 導體的大小相對於載流量及電壓降值是否足夠；（是否符合守則 13A 的要求）
(e) 所有器具是否正確連接，尤其是插座、燈座、隔離器、開關掣、電流式漏電斷路器、微型斷路器、及保護導體；（是否符合守則 6；9；10；11；25 及 26 等有關連接模式及方法的要求）
(f) 是否設有防火障及防止熱效應的保護措施；（ 是否符合守則 15B 的要求）
(g) 防止直接觸及帶電部分的方法 (在適當的情況下包括距離的量度)，即將帶電部分絕緣以作保護、或設障礙物或外殼以作保護；（是否符合守則 4C (2) 及 13B 等 的要求）
(h) 是否設有適當的隔離及開關器件；（是否符合守則 8 的要求）
(i) 保護及指示器件的選擇和調校；（是否符合守則 9 的要求）
(j) 電路、熔斷器、保護器件、開關掣、隔離器及終端的標誌；（是否符合守則 4D (1)；6A(b)；6B (3) ；8B (2) (g) ；8B (3) (a) (ii) ；8 (4) (d) (i) & (ii) ；8B (4) (g) (i) & (ii) ；9E (b) 等的要求）
(k) 因應不利環境情況的器具及保護措施的選擇；（ 是否符合守則 15 的基本要求）
(l) 是否具備危險及警告性的告示；（是否符合守則 17A；B；C 及 F 等的要求）
(m) 是否具備圖表、指示及其他同類的資料；（是否符合守則 6A (b) 的要求）
(n) 作保護或開關用途的單極器件，是否僅與相導體連接；（是否符合守則 10B 的要求）
(o) 故障防護的方法；（是否符合守則 11B ；11J (2)；26L (3)；26N (2) & (4) 的基本要求）
(p) 如何防止彼此產生不利影響；（是否符合守則 15 的基本要求）

(q) 是否設有低電壓保護器件；（是否符合守則 4C (2) (e) 的基本要求）

(r) 裝設的方法。（是否符合守則 25 及至 26 的要求）

21B 低壓電力裝置的測試

(1) 安全

進行測試時應採取防護措施，而所用的測試方法應要妥善（可參照工作守則 21B (3) 至 (10) 的方法及要求），即使測試中的電路出現故障，也不會對任何人或財產造成危險。

(2) 測試的次序 (a) 以下項目如與裝置有關,最好依照所示的次序進行測試:

(i) 保護導體 (包括總等電位接駁及輔助等電位接駁) 的連續性；

(ii) 環形最終電路導體的連續性；（主要是防止環形插座電路出現斷路，使電路 32 安培的過載保護無法保護2.5平方毫米電纜）

(iii) 絕緣電阻；（所得數據是否符合守則表 21 (1) 的要求）

(iv) 極性；（所得數據是否符合守則 10B；21B (6) 的要求）

(v) 接地極電阻；（判斷比較困難，因現今香港仍沒有絕對標準，不像絕緣電阻，守則附錄 12 (B) 核對表 4 (i) (ix) 的要求可作參考，但香港工程界用了多年的工程章程的要求是須小於 1 歐姆，在很多單一銅棒作接地極的工程是很難做到，而機電工程署認可的國標及英國標準亦有與香港不同的要求，有關論述請讀者們參考今期「今日機電」陳富濟老師的文章）

(vi) 接地故障環路阻抗；（所得數據是否符合守則 11B；11 (J) (2) (a) (i)；表 11 (8) 至 (14) 的基本要 求）

(vii) 各項保護器件的功能；（是否符合守則表 21 (B) (9) (a)；(b) 的要求）

(viii) 各項器件的功能。（是否符合守則表 21 (B) (9)(c) 的要求）

最後，我們的檢查及測試工作還必須符合下列工作守則 4 (D) (3) 的要求：

4 (D) (3) 檢查及測試

(a) 在電力裝置或電力裝置加設部分的工程完成後，必須進行適當的檢查及測試，以求在合理可行的情況下證實已符合線路規例 的要求。

(b) 在用戶載荷的供電點量度所得的功率因數應最少維持滯後 0.85，並應安裝所需的功率因數校正裝置。

(c) 對可能影響其他電力器具、其他服務或電力供應的設備特性進行評估。這些特性包括:

- ◇ 過電壓；
- ◇ 欠電壓；
- ◇ 波動負荷；
- ◇ 失衡負荷；
- ◇ 功率因數；
- ◇ 起動電流值；
- ◇ 諧波電流；
- ◇ 直流電反饋；
- ◇ 高頻振蕩；
- ◇ 附加接地裝置

能源效益的標籤 / 守則 / 審核

鄧文熙

乘車、工作、消閒等各種日常生活或多或少會做成碳排放，最後令溫室效應越來越嚴重，對地球生態的負面影響也越來越大，因此最近十多年開始，全球各地都致力於減排運動，務求大幅減低碳排放量，令地球的病情不會惡化。

作為一個世界知名的城市，香港也實施一系列減排的措施，根據環境保護署提供的資料，四種主要空氣污染物〈二氧化碳，氮氧化物，可吸入懸浮粒子，揮發性有機化合物〉的排放量在一九九七至二零零九年間削減了差不多 50%，同時，兩家電力公司亦推出一連串的計劃和行動，令香港的減排運動能達標。

另外，為配合減排運動，機電工程署亦推行了多個指引和條例。

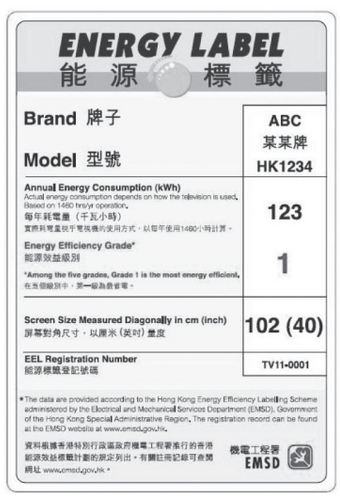
能源效益標籤計劃

分自願性和強制性兩種：

自願性能源效益標籤計劃包括多種器具及器材，家用的包括有電視機、家用儲水式電熱水爐、LED 燈、電飯煲、電動乾衣機、冷氣機、電磁爐、非整合式緊湊型熒光燈、電子鎮流器和住宅式即熱氣體熱水爐等；至於辦公室的器具及器材，包括有影印機、傳真機、多功能辦公室設備、打印機、冷熱飲水機、電腦、液晶體顯示器；此外，自願性能源效益標籤計劃亦涵蓋至汽油載客車輛。

自願性能源效益標籤計劃的《確認式》能源標籤

強制性能源效益標籤計劃是政府透過《能源效益（產品標籤）條例》推行，所有在本港供應的訂明產品必須貼上能源標籤，包括空調機、冷凍器具、緊湊型熒光燈（慳電膽），洗衣機和抽濕機。

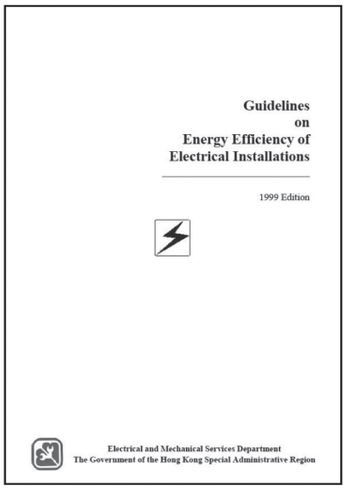


強制性能源效益標籤計劃的能源標籤

建築物物能源效益

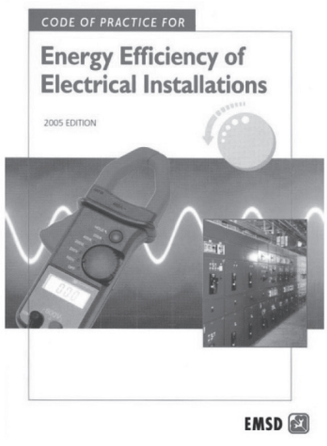
機電工程署在 1998 年已經推出了一系列的

『建築物能源效益守則』，分別列出照明、空調、電力和升降機及自動梯等裝置的能效規範，但由於當時並沒有法律規定，因此這套守則只是一個指引，客戶可自行決定是否採用。

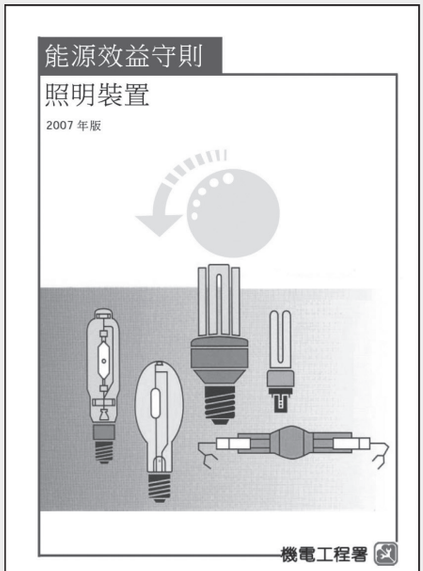


1998 年版的『建築物能源效益守則』的其中一冊

其後，機電工程署分別在 2005 年和 2007 年對『建築物能源效益守則』系列作出修訂，雖還未有法律規定，但很多工程已開始引用守則內的指引作為工程標準。



2005 年版的『建築物能源效益守則』的其中一冊



2007 年版的『建築物能源效益守則』的其中一冊

2012 年，機電工程署把『建築物能源效益守則』系列再次作出修訂，並把整套系列整合而推出『屋宇裝備裝置能源效益實務守則』，針對四個層面列出能效規範，分別為：

- 照明
- 空調
- 電力
- 升降機及自動梯等裝置

而且，根據《建築物能源效益條例》（香港法例第 610 章），此『屋宇裝備裝置能源效益實務守則』在 2012 年 9月 21 日起已經全面實施，所有於 2012 年 9 月 21 日或之後完成的工程，都必須遵照守則內制定的要求。

屋宇裝備裝置能源效益實務守則

建築物能源效益註冊計劃

為推廣及把建築物能源效益普及化，設計者、建築師、建築物發展商、物業管理機構等可聘請註冊專業工程師評估建築物是否符合守則的能效規範，合格的建築物可獲頒註冊證書，而且能使用『高能效建築物標誌』，根據機電工程署網站提供的資料，截至 2013 年 4 月，機電工程署共頒發了 3434 張證書予 1517 座建築物的 3589 個裝置。

能源審核指引

能源審核

要知道建築物的能源消耗能否達標或是否過量，其中一個最有效的方法就是聘請專業工程師進行建築物能源審核，專業工程師會根據建築物內的裝置和過往能源消耗紀錄進行計算及評估，並建議改善能源消耗的方法，改善方法主為分為三個類別：

第一類為只需投入非常小、甚至零的投資，就可改善能源消耗的方法，例如控制照明器具的開關時間，規定沒有人使用的房間內的電力器具必須關掉等；

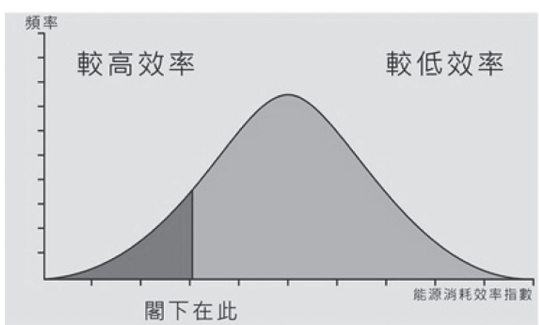
第二類為需要注入不算大數目的投資來改善能源消耗，例如在建築物內安裝時間掣或測光儀器等來控制照明器具的開關、安裝溫度計來控制冷氣系統輸出等。

第三類為需注入大量投資的方法，例如更換整幢建築物的空調系統、安裝智能化能源管理系統等。

香港建築物的能源消耗指標及基準

除了聘請專業工程師進行建築物物能源審核外，機電工程署網站亦提供了一個網上的計算器，只需輸入建築物的資料和數據，就能計算出建築物的能源消耗效益是高還是低。

http：//ecib.emsd.gov.hk/tc/



能源消耗表現

An Investigation for the Feasibility of Minimizes the Acoustic from Building Services Problems in Commercial Building (part2)

Ken Luk Wai Chung

Chapter 3

Improvement of "unwanted noise" in commercial building

3.1 Sound insulation and absorption

3.1.1 Sound insulation

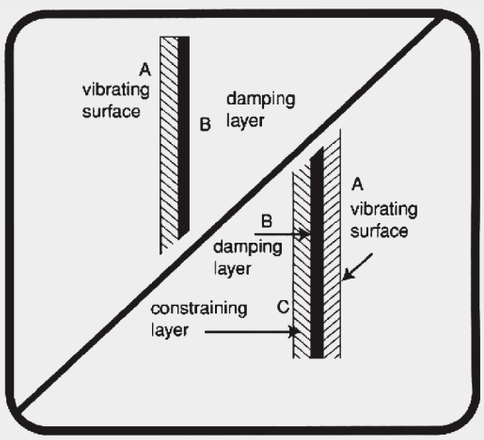


Figure 10 – Damping insulation diagram

It is important to avoid confusion between sound absorption and sound insulation.

(a) Sound absorption is the prevention of reflection of sound or alternatively, a reduction in the sound energy reflected by the surfaces of a room.

(b) Sound insulation is the prevention of transmission of sound or alternatively, a reduction of sound energy transmitted into an adjoining air space.

Two types of sound insulation are to be dealt with in building construction:

(a) Airborne Sound Insulation : the insulation against noise originating in air, e.g. voices, music, motor traffic, wind. In commercial building, the system noise comes from fan and pump motoring, vertical transportation up and down lifting, through the air transmission media.

(b) Impact Sound Insulation: the insulation against noise originating directly on a structure by blows or vibration e.g. footsteps above, furniture being moved, drilling and hammering the structure, etc.

3.1.2 Sound absorption

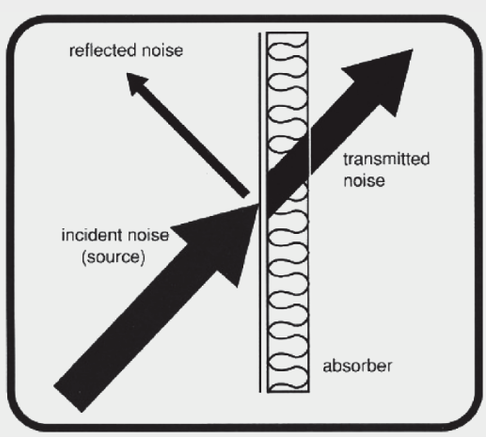


Figure 11 – Absorption diagram

Materials had porous fibrous and sometimes covered with protective membranes. Noise enters the absorber and is partly dissipated (absorbed) within the material. Some is transmitted. Some is reflected. Absorber performance is expressed as a decimal value. A perfect absorber is rated at 1.00. The higher the decimal value the more effective the absorber will be.

Noise Reduction Coefficients of Materials	NRC
Brick, unglazed	.05
Concrete block	.05
1/8" pile carpet	.15
5/16" pile carpet and foam	.35
Concrete floor	.00
Plaster, smooth finish	.05
Plywood paneling, 1/4" thick	.10
Water surface (as in swimming pool)	.00
1" thick fiberglass curtain	.70
3" thick "SONEX" wedge foam	.86
4" thick smooth surface foam	.89
4" thick metal panel	.95

Table 4 - Noise Reduction Coefficients of absorption materials

It was because we have defined sound as a form of energy. Sound absorption is the ability of a material to transform acoustical energy into some other form of energy, usually heat. All materials absorb some acoustical energy. Some materials such as gypsum board absorb it poorly, reflecting most of the energy that strikes their surfaces, while other materials such as fiber glass insulation absorb most of it.

Measuring sound absorption: The decimal fraction of the sound energy absorbed and not reflected by a material is termed its sound absorption coefficient. As materials absorb different amounts of sound energy at different frequencies, sound absorption coefficients are measured at one-third octave band center frequencies from 125 to 4000 Hz.

Building materials are generally rated by their noise reduction coefficient (NRC). This single number rating is the average of the sound absorption coefficients of a material at 250, 500, 1000, and 2000 Hz, rounded to the nearest .05. A material is usually considered to be a sound absorber if it has a NRC value greater than 0.35. The sound absorption performance of a material is commonly published as a table of sound absorption coefficients at octave band center frequencies from 125 to 4000 Hz. For example, Table 4 gives sound absorption data for CertainTeed CertaProTM Commercial Acoustic Board, Type CB 300 for reference.

		SOUND ABSORPTION COEFFICIENTS AT OCTAVE BAND CENTER FREQUENCIES, Hz						
Type CB 300 (unfaced)	Thickness	125	250	500	1000	2000	4000	NRC
	1" (25mm)	0.08	0.25	0.72	0.88	0.93	0.94	0.70
	1½" (38mm)	0.10	0.51	0.89	0.95	0.92	0.93	0.80
	2" (51mm)	0.21	0.73	1.08	1.04	1.04	0.96	0.95
	2½" (38mm)	0.31	0.81	1.08	1.02	1.04	1.03	1.00
	3" (76mm)	0.41	0.96	1.13	1.03	1.03	1.02	1.05
	3½" (89mm)	0.72	1.14	1.11	1.00	1.02	1.00	1.05
	4" (102mm)	0.75	1.18	1.09	1.00	1.00	1.02	1.05

Table 5 - Sound absorption

A new single number rating for sound absorption that will be replacing the NRC over the next several years is the Sound Absorption Average (SAA). This is the average of the sound absorption coefficients of a material from 200 through 2500 Hz inclusive. As is the case with the NRC rating, a material is usually considered to be a sound absorber if it has a SAA value greater than 0.35.

Note that sound absorption tends to increase with material thickness (but does not always do so). Also note that some values exceed 1.00. It is of course impossible for any material to absorb more acoustical energy than that which strikes its surface. However, sound absorption measurements of highly absorptive materials often yield sound absorption coefficients greater than 1.00 due to diffraction effects. These values are reported as required by the test standard. When using sound absorption coefficients in calculations, values above 1.00 should be reduced to values less than 1.00. Differences noise level reduction coefficients as small as 0.05 in which cannot be detected by the human ear.

The sound absorption coefficients of a material are used to calculate the sabins of absorption when that material is used. The sabin is the unit of measure of sound absorption in the English system of units. It is equal to the sound absorption coefficient of material times the area of the material used. For example, if a material has a sound absorption coefficient of 0.57 at 500 Hz and 250 square feet of this material is used in a room, then the sabins of absorption for this material at 500 Hz is 0.57 x 250 = 142.5 sabins. The sabins of absorption are used to calculate noise reduction in a room and reverberation time which are discussed in later paragraphs.

To be an effective sound absorber, a material must have interconnecting air pockets or cells. For example, the fiber glass insulation is a very good sound absorber because it has many interconnecting air pockets. Other effective sound absorbers, called resonators, typically employ small perforations or slots that allow sound to enter but not to escape easily. Wood slat panels and slotted concrete masonry units operate on this principle.

Sound absorption is used to control or reduce sound within a room, unlike sound transmission loss—which is used to describe the transmission of sound from one room to another.

In addition to reducing the sound level in a room, the addition of sound absorption in a room can also reduce the room's reverberation time. This is the time in seconds that it takes for a sound to decay or decrease 60 dB in level. For good speech intelligibility, the reverberation time in a room should be less than 1.0 seconds.

As was discussed in the section Sound transmission and noise control, when a noise source is enclosed to reduce the transmission of noise, the inside surface of the enclosure should be covered with a sound absorbing material. This is because a noise enclosure with high sound insertion loss properties will increase the noise level inside the enclosure because the sound is trapped inside the enclosure.

3.2 Acoustic Design

3.2.1 Acoustic installation in commercial building

3.2.1.1 From the design stage of an commercial building, the building architectural or Acoustic Consultants Division had responsible for offers

an extensive range of services in relation to the assessment, measurement, prediction and analysis of noise and vibration within the building and architectural acoustics sector. Expertise covers the full range of building types and projects and the Company endeavors to provide clients with relevant, high quality, cost-effective advice to achieve silent environment.

After takeover the property, the landlord, management teams, or occupants themselves can consider the flexibility to fix additional acoustic enclosure in affected area of the building. There are many kinds of acoustic enclosures can be selected to fix to avid noise transmission directly to affected within the commercial building. An acoustic enclosures offer a cost effective solution to one or a number of noise sources within a working environment. Consideration should be given to maintenance access, product access, services, ventilation and visual requirements all of these factors will affect the performance of the enclosure. Acoustic Control Systems will design the enclosure in consultation with users and maintenance personnel, supply and fit the enclosure to suit your requirements.

An example of one of our acoustic rooms is shown below the room encapsulated noisy machines within a workshop and isolated personnel working outside, on the shop floor, from the noise of the machines inside.

3.2.1.2 Acoustic Barriers offer another solution to a noise problem where the noise source must not be enclosed, for example where air circulation or frequent access is required.

Acoustic panels can be supplied custom manufactured to your requirements. The panels are manufactured from sheet steel and can be supplied in a variety of constructions and finishes to suit your application and noise reduction requirements please contact us for further information and prices.

3.2.1.3 In MVAC system, fan noise can be treated in two ways either by fitting duct silencers or acoustic enclosures around the fans. Sometimes a combination of both is required. We can measure and assess fan noise on site and design equipment to suit your requirements. Below are examples of fan acoustic enclosures and silencers

Figure 12 – Acoustic workshop

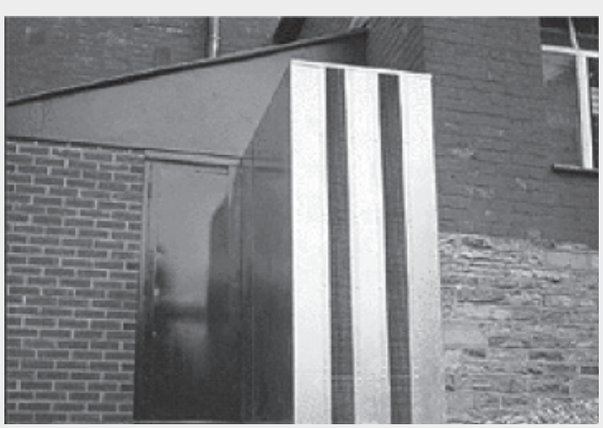


Figure 13 - Compressor room treatment Figure

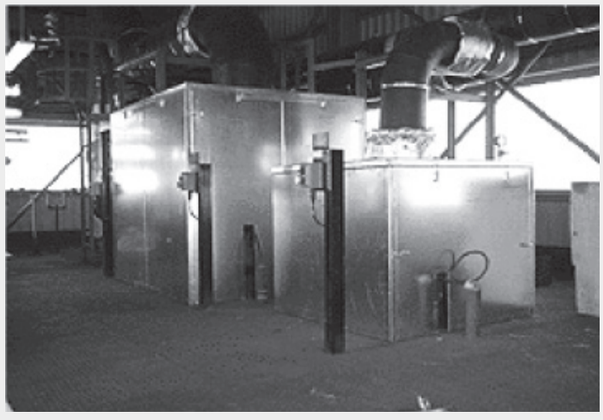


Figure 14 – Fan enclosure

3.2.1.4 Live reverberant (echo), noisy rooms can be made more desirable by the addition of sound absorbing equipment below are two examples of room acoustic control:

Figure 15 – office noise absorption

Figure 16 – home acoustics

3.3 Acoustic Maintenance Management

3.3.1 Workmanship and Maintenance

Monitoring and regular inspection in both of E & M system should be performed even in the construction, installation, alternative and additional works. This was equivalent of the workmanship mentioned in regarding to even in environmental noise (acoustic) management system that carried out by professional engineer or competent person.

Good workmanship should be continuously carried out in building services management, which was not only in acoustic management. The sound cannot be seemed indirectly, but avoid by insulation method (From the following chapter, I will proved that NC testing or observed by the best way for restrict the acoustic enclosure which isolated / separated with affect another system.

From the MVAC system in commercial building, in order to prevent increasing noise produced by existing equipment, it is necessary to put in place a regularly scheduled equipment maintenance programme, so that equipment is properly operated and serviced in order to maintain controlled level of noise and vibration. Good practice of new installation was important to avoid or minimize the noise created from the building services. Meanwhile, good maintenance may include lubricating moving parts, tightening loosen parts, inspection of vibration devices, acoustic material checking, replacing worn out components or inspecting equipment alignment, etc. Vibration measurements at various frequencies may help to detect causes of excessive vibration or noise of a machine.

Chapter 4

Methodology of acoustic management solutions

4.1 Selection of Method

4.1.1 By interview

A. Reasons for interview

- Specific knowledge

Interview is quite different from questionnaire; it was because of the subject involved some technical and professional knowledge between the systems. Accordingly some of idea should be subjective or different apprehension. By visit with Fellow Professional, I learned from a short-interview that in order to obtain technical advices, specific comments and professional knowledge for explanations on the problems of unwanted noise in the existing building service in commercial building

- Easy for interview

Find out the research from face to face interview, via directly conversation with some fellow professional of their experience, share-feelings, technical opinion and personal advice confabulate in which attest, analysis or even responsive my investigation.

- Selection of interviewee

Have higher qualification and experience in related to soundproofing system and acoustic management in fellow who will become the object for interview.

Interviewee A: Ir. Jeffrey Yung, Associate Director, Technical Service and Facility Management who worked in ISS EastPoint Property Management Limited, Cyberport Facilities Management Office in Cyberport – main famous intelligent commercial building in Hong Kong. Ir. Jeffrey Yung was also the Honorary Secretary 2006-2008 of Society of Operation Engineering (Hong Kong Section).

B. Interview Schedule

According to the interviewee for the time and location of interview can accommodated with them. Basically, all of them should be made appointment in advance for invite to accept 30-45 minutes interview. The schedule of interview can be found in the following:

Location:	Meeting room at Cyberport Facilities Management Office Unit 401, L4, IT Street, Core A, Cyberport 3, 100 Cyberport Road
Date and Time:	at 20:00 to 21:00 on 17 April 2008

C. Questions of interview

There are totally 10 questions to be prepared for interview which related to acoustic system and advices for affected to Facilities Management. The questions are shown in the following clause 4.2 information collection.

4.1.2 By Experiment on site testing

Technical theory and investigation through on-site sub-sequence testing, calculation with supporting statistic analysis, code of practice and other issues.

On site testing will be carried out at the new commercial building addressed, Cheung Sha Wan 909 (One of a new typical commercial building located at Kowloon side in Hong Kong) concerning with the acoustic arrangement in works.

A. Reasons for on-site testing

- Easy for testing

Close by MVAC and Pump room with working environment – Cheung Sha Wan 909 where there is general acoustic enclosure (by using gypsum board and sound foam material) to cover / enclose the surrounding area from running mechanical motor but somewhere was without proper enclosure. We had taken the measurement from time to time in which to investigate

the different sound level measured in both of under operation or static condition (measure the background noise only).
Therefore, it was very easy to measure the different figures between the well acoustic management and without anything;

- Selection of testing
Aim to attest the result of NC testing system by using typical sound level meter which is more sensitive affected by surrounding environment proximity. It should be connecting with some other reliable some accurate electronic equipment to support, e.g. Analog Soundproofing Oscilloscopes. Alternatively, testing will be more expensive, cost inefficiency and needed to laboratory support certificate. As the testing result should be proofed by historical theory we learned before.

B. Preparation and Process

- Testing schedule
Simple material and tools, testing devices, auxiliary & equipment should be well prepared. The test was carried out by me and assisted by my dear technical colleagues at the commercial building in Cheung Sha Wan 909. Assume the different chiller water pumps were under uninterrupted operation while testing period except the bypass operation was pre-set to avoid system failure. Thus, we turn off partial pump in testing by manual and enable the pump(s) for sequence testing. Meanwhile, we stay in chiller water pump room for the whole days for carry out the sound testing; in order to prevent our ears, ears plug must be worn on time.
From the chiller water pump room at R/F, we try to measure the sound level from different period of building system operation schedule within a one hour.

- Testing equipment
Unwanted noise especially between Chiller plants and pumping system occurred during maintenance, repairing, reinstatement work and other new project. Measurements for background noise will be taken at the specification locations.

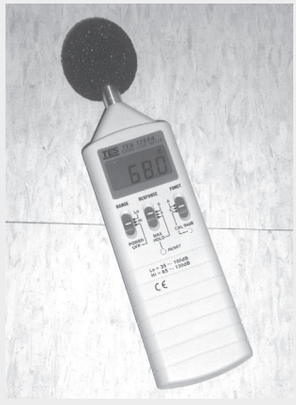


Figure 17 - TES-1350A Sound level meter

- Testing procedures
A calibration check will be carried out on the precision integrating sound level meter with the sound level calibrator. Measure for system noise will be taken at the specified locations.
From the following floor plan shown the clouded area was the existing chiller plant room on R/F of Cheung Sha Wan 909. Referring to Appendix I - Roof plan of Cheung Sha Wan 909, where there are chiller water plant room and adjacent A/C Chiller room without any acoustic design even though new commercial building recently.
We are now preceding the noise measurement just in the chiller water plant room:

1. Establish the proper sound level testing point surrounding the chiller water pumping system from the east, south, west and north direction of pumps far from the distance 1 to 2.5m from the different testing point to place between Chiller Water Pump No. 1 to 4 (from left to right). Referring to Appendix II – Chiller water plant room at R/F of Cheung Sha Wan 909
2. Prepare acoustic barring material - These barriers sized in 1.2M in height and 2.2M in width have timber finishes on both sides and blends well. The absorptive face consists of a black breathable membrane, 25 x 25 black weld mesh and 17 vertical chamfered timber trim at

the bottom. Five barriers named as B1, B2, B3, B4 and B5 in sequence from left to right. Referring to Appendix III – Testing point and acoustic barrier in Chiller water plant room This test is to determine the airborne sound insulation of chiller pumping building system. The measurement is performed in a special sound level meter in which the transmission of sound on air paths is suppressed. This result of the testing was anticipated from the following parameter accordingly in which to indicate the sound transmission from airborne sound insulation:

1. Distance of testing point – how many sound transmission from the source of noise;
2. Measurement period – Indicate the period of system noise;
3. Barrier placed – Compare with the different from the acoustic management approach;
4. Consolidate the aforesaid information to analysis the functional of the acoustic control from the media of airborne sound insulation.

The testing and resultant sound levels in details are listed as follow:

Step	Testing Point	Chiller Pump operation	Measure Starting Time	Measure End time	Barrier placed	Average sound level (dB)
1	1	All	10:01	10:15	Without barrier	120
2	2	All	10:16	10:30	Without barrier	124
3	3	All	10:31	10:45	Without barrier	135
4	4	All	10:46	11:00	Without barrier	136
5	5	All	11:01	11:15	Without barrier	130
6	6	All	11:16	11:30	Without barrier	101
7	1	1	12:01	12:15	With B1	86
8	1	1,2	12:16	12:30	With B1, B2	82
9	2	1	12:31	12:45	With B2	124
10	2	1,2	12:46	13:00	With B1, B2	84
11	3	1	14:01	14:15	With B2, B3	90
12	3	1,2	14:16	14:30	With B2	126
13	4	2,3	16:01	16:15	With B3	94
14	4	3	16:16	16:30	With B3, B4	91
15	5	3,4	16:31	16:45	With B4, B5	90
16	5	4	16:46	17:00	With B4	85
17	6	3,4	17:01	17:15	With B5	83
18	6	4	17:16	17:30	With B4,B5	86

Table 5 - Sound absorption

4.1.3 Case study

From the experience sharing with interviewee, who met with the similar case of acoustic system. Cases also explored from the complaints of client in my working environment, Cyberport, the end user who reflected the existing “abnormal and unwanted noise" problem from suspended building service system.

We can also find out some information from the device indicator, trend-logged data and compared with the advice from him. It was because there is Intelligent Building Management System

(IBMS) to monitor the building system operation in Cyberport since 24 hours. The abnormal noise was suspended comes from adjacent MVAC system, for example, VAV box, air fans or return air pressure, etc. The technical operator tried to adjust the air flow or operating schedule from BMS if the helpdesk received call of noise. The source can be identified if the condition was improved immediately, and we will arrange to modified the "source" by in-house staff that can be shown and identify the evidence of captioned which is true or false.

4.2 Information collection

Conversation of interview

Hereinafter, sort only one interviewee in namely Ir. Jeffrey Yung (JY) in conversation.

Firstly, I asked them that in their opinion, what are the advantages / disadvantages of acoustic management if found unwanted noise in the existing building system. JY mentioned the highest sound level make mostly civil servant or officer's temper annoyed and impatient. The unwanted noise in building system from Cyberport was mostly comes from chiller plant, the second was pumping system and air side system in office area at Cyberport. Of course, the relationship between the designated system and acoustic management was directly affected how many level of "noise" was measured. Ir. Jeffrey Yung foresee the level of noise concerned that the higher dB was measured when partially chiller pump was under operated, the technician must wear the ear protective equipment in case of repair or maintenance to protect the ear.

From the air side system, the air changes from Air Handling unit (AHU) transfer to variable air volume (VAV) boxes to the working spaces through nozzle where are sound of the "wind" from the variable air pressure from static to variable condition was being affected across the duct, fitting and control device. This sound of the wind will give the office a continuously nuisance from a quiet environment office area.

By on-site testing

By using sound level meter to measure the sound (dB) close proximity with operating sound generated by Chiller plant and fresh water pump occur from it, I take five or six testing points from different co-ordinates within specific period to test how many "unwanted" noise occur during building system operation. Based on the location of the testing point, which and how many pumps was operating on time and which one or more barrier was enclosed to reflect or absorb the noise from the pumps.

By Case Study

- Complaint of abnormal noise due to the variable air change from AHU to VAV box in Cyberport occurred sometimes, the situation was always concerned with the pressure setting of the opening of VCD between the air ducts in the office area.

From some of fit-out works of tenant, the disturbance sound was always explosed without adequate enclosure of fitting out working area. In some office area, except the return air or fresh air supply will provide to the working area, there, to avoid the disturbance of neighbor office area, the technical team of facilities management office must remind the tenants' contractor or project coordinator should pay attention on the ambient factor in case of acoustic control while proceeding the fitting out work before starting to work.

4.3 Information analysis

Similarly, the data analysis can be separated by different method of research. Justification can be proceeding, summarized and consolidated the major consideration as result.

By interview:-

From conclude the answer of the three interviewee, I can know that the general problem

which facing to the status of how does acoustic management was carry out as the same as my assumption. Of course, the information should be externalized due to individual interview.
Even the subjective by only one interviewee, Ir. Jeffrey Yung, but there are many major advice especially not carried by facilities management but earlier involved are highly recommended.
They also emphases the survival value of practice for minimize the acoustic problems and common technical point of view that should be solved by other solutions.

By on-site testing:-
Examination on site testing either individually or in the combined method, data obtained to evaluate the noise level, reaction, weakness, etc. and the resultant information for statistical analysis to prove that acoustic enclosure is right or wrong of installation after tested. Six testing points concluded that reflect for achievement of the acoustic enclosure coverage can absorb / restrict the sound transmission of building system through the air the theory of overcome the nuisances of noise by different isolation ,proper location from partitioned separation from air-spaces, isolated by different acoustic materials, etc.

By Case Study -
The following outstanding issue was major advice that should be investigated for studies the probability of minimize the problems of noise and establish the well acoustic management:

- Selection of material is correct or not;
- Workmanship in installation;
- Acoustic protection, insulation, separation or others;
- Space (zoning) consideration;
- Evaluation of the valuable for cost investment in equipment;
- Benefit review in initial and running cost;
- Effectively and efficiency of cable management;
- Others.

From above methodology, information, data analysis and advice should be summarized in mainly five criterion which can be outline the feasibility for improvement of acoustic problems from building service system in commercial building:

1. Recognition of the distance of the acoustic material between the sources of noise is essential from airborne sound transmission testing
2. Existing remediation methods are enough for minimize the noise problems in commercial building
3. Root causes of the unwanted noise were generated between air and structure transmission compare with the others.
4. How can we fix the problems or even if minimize the level of unwanted noise from the commercial building.
   Except acoustic control from building system can be consider to fix, for example, the acoustic barrier, enclosure, louver, anti-vibration device and installation, etc.
5. From facilities management point of view, how can we do if the system operation affected the occupant in commercial building?

4.4 Performance analysis

- Analysis of the case study.

From integrated analysis in consolidated research summary, abstract the main and common points for analysis. Subjective advice and objective case studies reflected the actual situation of acoustic control / management from the operation of existing building system in commercial building. The different advice and suggestion from interviewee, the discussion should be valuable for outline if two or more of them agreed or reflex the same advices.
Different from the research method of questionnaire, the figure(s) cannot be assessed by calculation or statistic method. Case studies sharing could be analysis the situation in history that was

believable.

- Solution or recommended action and justification.

Some technical guidelines for avoiding noise problems in acoustic management as:

1. Individually packaged acoustic control with system separated (or zoning) in the location of building system. For example, individual damping on the chiller pump and aluminum metallic enclosure with sandwich rock wool material
2. Shielded enclosure or soundproofing material could be used.
3. Good craftwork from material selection, installation to the maintenance stage in earlier design (acoustic) management.
4. Additional monitoring equipment is necessary if budget approved.

- General lessons to be learnt from the case study.

From my learning of electrical engineering course in 1990, laboratory test carried out to assess the sound transmission characteristic and studying the acoustic protection theory. Nowadays, the on-site testing is adequate for me to prove the theory into practical application. In working experience, negative finding (sound control) in acoustic management can be bought me to think about the solution in my limited knowledge.

From studying the building service engineering, the view had been changed into broadly and forward-looking. Though the dissertation, combined with cost consideration, the feasibility of minimization for acoustic control should be facilities manageable but long-term investment is needed.

4.5 Cost saving and reliability of sound improvement

Owing to maintain the continuously for minimize the acoustic problems and prolong the comfort (office) working environment due to acoustic management, the selection of materials in construction stage should be considerate properly investment even though the professional workmanship with technical skill and allocate the goods and material. Architects must consider the further management in building service system with proper acoustic control and discussed with Engineers as possible. Aims to improvement the nuisance, disturbance or affects from the design stage to Management Company. Recently, most of the commercial building would like to be rented for some office tenant or occupant because of their business; decoration cost should be valuable for target stability on minimize the noise comes from internal office area. And the building owner can consider providing specific acoustic facilities, controlling device or additional installation which can improve the condition.

But I regret that the acoustic management was not still common or attention in most of existing commercial building in Hong Kong. As we also understanding, from long term, the maintenance cost can be trimmed down or not in which subject to the compatibility between the acoustic and building service management. Therefore, some acoustic facilities or installation can be found especially in some of the large-scale of commercial development buildings.

4.6 Minimize the problems from building service system

4.6.1 Design and project stage

From the commercial building service or facilities, we found that the location of equipment affected the office area in majority. The installation position of equipment is of critical importance in determining the noise level at the affected noise sensitive receivers (e.g. residential buildings or schools). From this paper, in the

commercial building, where practicable, the equipment should be placed in a plant room with thick walls or at a much greater distance from the receiver or behind some large enough obstruction (e.g. a building or a barrier) such that the line of sight between the receiver and the equipment is blocked. If noisy equipment has to be placed near a receiver due to spatial or other constraints, sufficient noise control measures should be considered. Some chiller plant was located in the podium where enclosed by acoustic panel and it's a ventilation system of a new development, which has been equipped with adequate noise control measures in the design stage to prevent noise problems. And vice versa, the other pumping system of a new development was as similar as MVAC system.

Of course, Architect can consider if the building facilities and related services system can be designated with well acoustic control, for example, anti-vibration device on each motorized equipment, soundproofing, location of the plant rooms and acoustic building design, etc in which can be minimized the noise problems from commercial building.

4.6.2 Selection of material

On average, quieter equipment may generally be more expensive. But it always can protect at least 90% of unwanted noise from the building services if properly selection of acoustic material.

However, it is almost always more economical in the long run to buy quieter equipment than to reduce noise by modification after purchase (e.g. silent type chillers or water cooling tower and silent type pumps). Most equipment has a range of readily available noise control devices that are able to deal with the noise problems. It is advisable that noise levels specification is included when ordering new equipment. This allows the equipment suppliers to select appropriate equipment and optional noise control devices to suit the acoustic requirements.

A. Sound absorption material -

Sound Form

The two most commonly-used sound absorption materials are high-quality acoustic foam and specialized acoustic fiberglass (no, not the stuff you buy at the hardware store). It will be generically call acoustic foam just plain "foam," although there are very dramatic differences in cell structure and density between acoustic foam and the thousands of other types we could manufacture.

In addition to the two most popular types of acoustic absorption materials, "Auralex" offers a Class A, fire resistant, natural fiber panel called "SonoFiber". "SonoFiber" acoustic panels are the perfect solution for those budget-conscious projects requiring a Class A fire rating without the aesthetic demands of designer treatments such as fabric-covered panels.

Acoustic sound absorption foam is well-suited to alleviate slap and flutter echo, the two most common problems in rooms not specifically designed for music recording and performance. In fact, foam can turn even the most cavernous warehouse or gymnasium into a suitable acoustic environment

Honeycomb panel

This is an extremely economic sound absorption product. It is a flexible, self-extinguishing, open-cell, polyurethane foam. Ideal as a sound absorber principally in the mid to high frequency range. Low frequency absorption and/or vibration damping characteristics may be enhanced by the addition of various films, membranes and barrier layers. Recycled Foam Absorber without facing

Facing

This is the other sound absorption material lay on the wall surface which usually in pump room,

chiller plant or high thermal effect environment. An aim to absorb the sound comes from the mechanical equipment, facilities or installation.

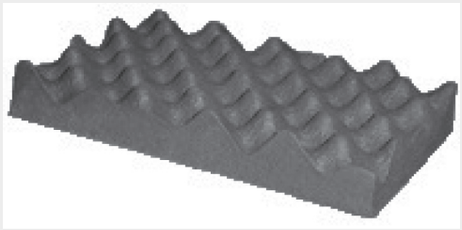


Figure 18 - Black PVC coating applied to profiled Sound Foam 0

Rockwool

Rockwool stone wool has an open fibrous structure making it ideal for absorbing and regulating noise. Rockwool products reduce ear-deafening noise from machines or the activities of people, and provide ambient situations that allow normal conversation.

Rockwool sound range is specially designed to provide a comprehensive choice of sound insulation that meets the requirements of the approved soundproof performance in basis.

B. Sound insulation material -
Acoustic insulator (Fiberglass ceiling, insulation board, panel, etc)

Acoustic blanket

There are many types of noise insulation quilted blankets. They are extremely flexible with a high degree of durability and fire resistance, and are resistant to most common fluids, mineral oil and petroleum.

They can be supplied in our standard sheet size or can be supplied as individually tailored parts to suit your own particular application. The blankets can be stitched and edge bound and can also be supplied with eyelets or Velcro for fixing. There is the most flexibility that material to be used for sound insulation / separation

Damping

Noise damping sheet is a self-adhesive pad used for sound and vibration damping on metal panels. The adhesive side is smooth, giving complete contact with the underlying surface without air pockets or channels. It is odorless, wear-resistant and impregnated to prevent the absorption of water. Both the pad material and adhesive can withstand temperatures between -30ºC and +120ºC (-22ºF to +248ºF) and are highly resistant to aging

This was use to reduce noise radiated from vibrating surfaces. Damping sheets (coatings) take many forms. These are mastics for spraying, troweling, etc. and there are tapes and sheets with pressure sensitive adhesive. Damping treatments are sometimes combined with absorbers. This is expressed as a "loss factor" which is the damping/stiffness ration of a material.

4.6.3 Acoustic protection

There are sound transmission through walls from the building, thus, the sound insulation in the plant / system rooms should be protected. Noise Barrier may be installed in conventional wall construction.

The barrier is like a big slab of 1/8" thick cheese, heavy and limp. The SAB is like a big shredded wheat. Both are easy to cut with a knife and neither is meant to be left exposed outdoors but could be left exposed indoors.

The actual difference between the "staggered stud" and the "standard stud" arrangement (diagrams below) differs very little with regards to acoustic performance. A great deal of difference can be realized by replacing the Fiberglas filler with our S.A.B. (sound attenuation board) because it is roughly 10 to 12 times as dense as standard fiberglass batts while only 2" thick.

Official testing is not available using our S.A.B. as part of these 2 diagrams and therefore no published result can be provided. Tests do show that

the NRC (Noise Reduction Coefficient) of Nominal 6 pound per cubic foot S.A.B. has an NRC of 1.05 (for 2" thickness) which is estimated to be 4 times higher than standard building insulation. Additionally, while it is not published, nominal 6 pound per cubic foot S.A.B. also adds to sound transmission loss (the actual reduction of sound transmission through a substance or combination of substances) because it weighs about 1 pound per s.f. (the same as the "EB1" barrier, itself).

For better results still, consider using a decoupling layer of foam tape (we stock in 1-1/2" x 54' rolls) This is installed between the drywall and the barrier and/or the barrier and the framing members to "decouple" the sheeting from the rest of the wall system. See "helpful diagrams" below.

Material for providing acoustic protection against a source of noise, the material comprising a substrate and resonators, wherein said resonators formed on the substrate are constituted by thread-like and/or area-occupying composite elements whose structural characteristics (density, modulus of elasticity, shear modulus, damping factor, piezoelectric factor, etc. ...) and whose shape and/or size are selected to associate a predetermined resonant frequency with each resonator, and also to absorb the sound pressure energy from the noise source at said resonant frequency and dissipate it in the form of mechanical heat energy and/or electrical energy. The invention also relates to apparatus constituted by a wall including at least one layer of the above material.

Chapter 5

Evaluation for the Benefit of Acoustic Management

5.1 Allow for possible changes in requirement after installation

In modification work of cable system, the use of different kinds of soundproofing material could be more reliable in problem preventive or minimization. Even if the building service system cannot be changed or don't be removal, or had been installed or rectified, the acoustic control was additional install by the party of building takeover (building management company) mostly. But it should be easier to change or improve because the acoustic modification without any large amount of additional cost and bulky independent control system. Thus any additional anti-vibration system (in prevent structure born sound transmission) or acoustic enclosure material (in prevent the air born sound transmission) in pre-set installation.

5.2 Prolong the lifespan of equipment and reduce the sound generation

- Building structures and their production technologies for buildings and structures, industrial and agricultural purpose in conventional and severe geotechnical conditions under seismic and it acoustic impacts;
- Moveable structures to avoid structure borne and vibration;
- Building mechanics of buildings and structures in different building service conditions and their operation consideration in terms of acoustic management;
- Building acoustic and thermal technology;
- Methods and means of study of building structures including additional soundproofing installation, barrier, tools, equipment.

5.3 Strengthen the acoustic comfort in the building

5.3.1 Consider the developments of criterions of valuations of levels rustled from sources of noise, acoustic properties of materials and building constructions, and also parameters of an acoustic climate in locations and from the outside of locations;

5.3.2 The creation of bases for installation of an acoustic climate in commercial buildings, and also in an environment;
5.3.3 The creation of specifications for constructions, building service system arrangement that answer acoustic norms, and also equipment and installations;
5.3.4 The guard from unfavorable influences of an environment in space management (between the system and building management in terms of acoustic control) and behind their limits to be consider especially in the design stage.

Chapter 6

Recommendation and Conclusion

6.1 Recommendation of acoustic management

In general, I would like to explain from MVAC and pumping building system in the building
which is the most serious in unwanted noise while the system in operating affected the nearby occupant in office area.

A. MVAC system

Noise generated from air-cooled (or water-cooled) chillers may cause noise disturbance to nearby the office area. It mainly comes from the air flow noise resulting from air turbulence at condenser fans and compressor noise during running and on/off cycle of refrigerant. There are some remedial methods for minimize the problems:

1. Erect a barrier or partial enclosure between the plant and nearby residential buildings so as to block the noise propagation path
2. Fabricate a complete enclosure with silencers at condenser fan outlets and at air inlets of the enclosure so as to contain and absorb the noise from the chiller when there are noise sensitive receivers all around
3. Install floating floor so as to reduce air-borne noise transmission through floor slab when the floor underneath is a noise sensitive receiver.
4. Vibration from a water cooling tower's and other supply or return air fans operation may be transmitted indoors through building structure at points where the cooling tower is rigidly fixed to the structure without proper isolation. The vibration transmitted may activate the building structure to generate noise which causes noise disturbance to residents inside the building. Provide vibration isolators to support a cooling tower, thereby isolating it from the building structure
5. The noise problem associated with fans may cause noise disturbance to nearby residents. It mainly comes from the interaction of flow turbulence and solid surface of fan blades, and blade / fan vibration. The noise is transmitted upstream and downstream in the connecting ducts or to the atmosphere through the fan case.

- Reduce the speed of fans at non-rushed hours.
- Divert duct openings away from receivers
- Install a silencer at air discharge point of a fan so as to absorb noise generated from the fan.
- Fabricate a complete enclosure to contain and absorb the noise energy radiated by the source

6. Air flowing through ducts induces vibration at the duct wall, which generates rumbling noise. In addition, the noise inside the duct can be transmitted to the atmosphere through the duct surface. All of these may cause noise disturbance to nearby office area:

- Stiffen the vibrating duct surface with supporting webs so as to reduce the movement of the vibrating surface.
- Apply damping material to the vibrating duct surface so as to reduce the movement of vi-

brating surface.
- Apply composite lagging of sound absorbing materials to contain the radiation of noise.

B. Pumping system

1. Water flows in a pipe causing vibration at the pipe wall and generating broadband noise which may cause noise disturbance to nearby the office in the building. When the water flow changes direction suddenly because of obstacles in the pipe such as sharp bends or valves, a loud noise is generated this becomes louder with increasing water flow rate and pipe size.
- Use pipes with larger radius bends so as to minimize vibration of pipe walls.
- Use rigid mountings around the bend with suitable vibration isolators to minimize pipe vibration.
- Apply pipe lagging to damp the pipe ringing noise
- Use a larger pipe or adjust water flow velocities to below 2m/sec to minimize pipe vibration.

2. Vibration from the water flow in pipes may be transmitted from the pipe runs to the interior of the building through building structure where the pipes are mounted. It becomes more severe when the pipes are in direct contact with large planes such as walls or slabs. The vibration transmitted may activate the building structure to generate noise which causes noise disturbance to residents inside the building:
- Use vibration isolators for attaching pipes to walls, ceilings or floors, thereby isolating them from the building structure.
- Isolate pipes where they penetrate the slabs and walls by compressible materials, such as rubber sleeve or glass fibre packing, thereby isolating the abnormal sound transmission from the building structure.
- Install pressure reducing valves, water hammer, water arrestor, frequency inverter to regulate water pressure and hence the water flow, thereby reducing vibration and sound transmission through the pipes.

3. Vibration from an operating pump set may be transmitted to the interior of the building through building structure when the pump set is directly mounted on a supporting structure without proper isolation. The vibration transmitted may activate the building structure to generate noise which causes noise disturbance to residents inside the building:
- Provide an inertia block to support the pump set so as to add rigidity and stability to the pumping system, and provide vibration isolators to support the inertia block, thereby isolating it from the building structure
- Provide flexible connectors between the pump and associated pipe work, thereby preventing the vibration of the pump set being transmitted to the pipe work

6.2 Conclusion

In order to achieve adequate immunity to nuisance from noise in building services effectively and economically, it is essential to consider the compatibility on the building system at all stages of design, especially in the earlier design stage of commercial building construction. The development, manufacture and installation of equipment can foresee how many building services system are used and how to manage it flexibility on the issue on soundproofing and noise. Early involvement of Facilities Design & Management can be considerate that the importance should be raise out at the beginning of construction stage.

From the cable manufacturer, the shielded, isolation, system operation and overall protection should be anticipated. The implementation of preventive measures at a late stage will almost certainly result in extra effort and cost, may created a reputation for unreliability. Design and installation guidelines can provided how can minimize the acoustic problems in the buildings.

The outcome from investigation to merge with the culture of existing building service system, development of acoustic management in building service engineering, I believed that the flexibility of operation by using acoustic installation is the one of the technical problem in building service system of commercial building. Except the involvement of building service management and congenital factors, for example, space, investment in acoustic management, foresee-ability and preventive maintenance. Cost should be critical in acoustic management due to maintain the system under normal or good operation in quality and management even though acoustic material and installation to be used.. Developer must be consider and balance on the investment and how can get it back or beneficial in business enhancement of commercial building.

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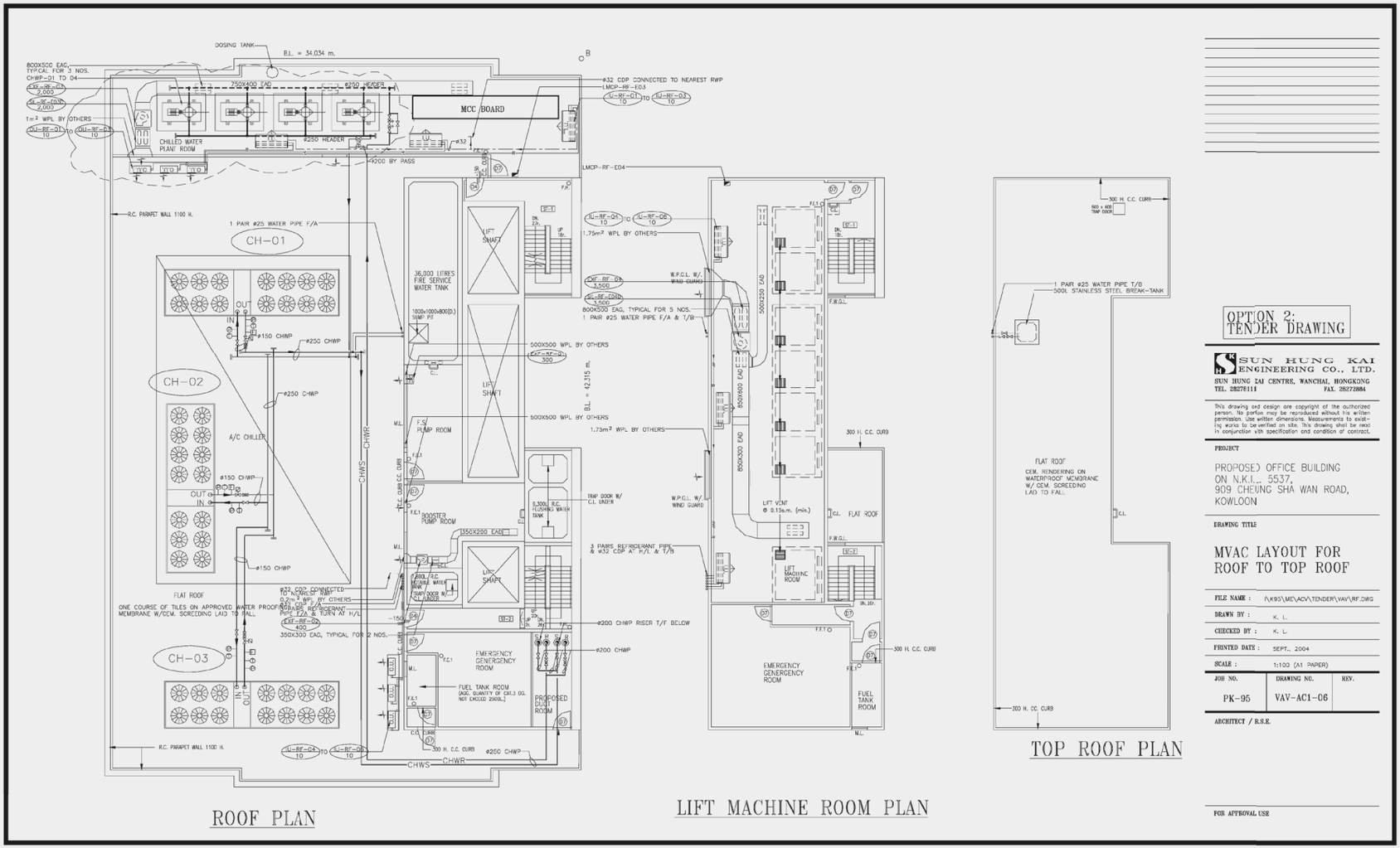
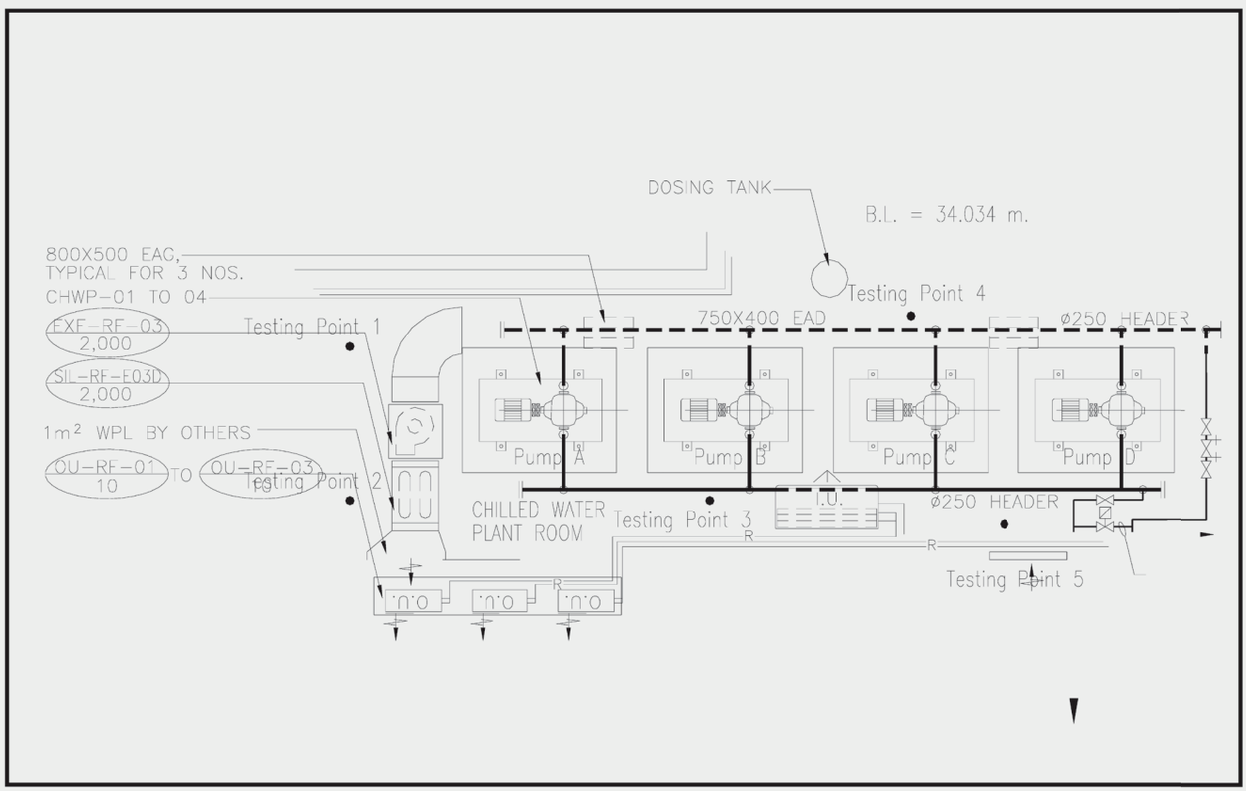
Appendix

Appendix I - Roof plan of Cheung Sha Wan 909
Appendix II – Chiller water plant room at R/F of Cheung Sha Wan 909
Appendix III – Testing point and acoustic barrier in Chiller water plant room

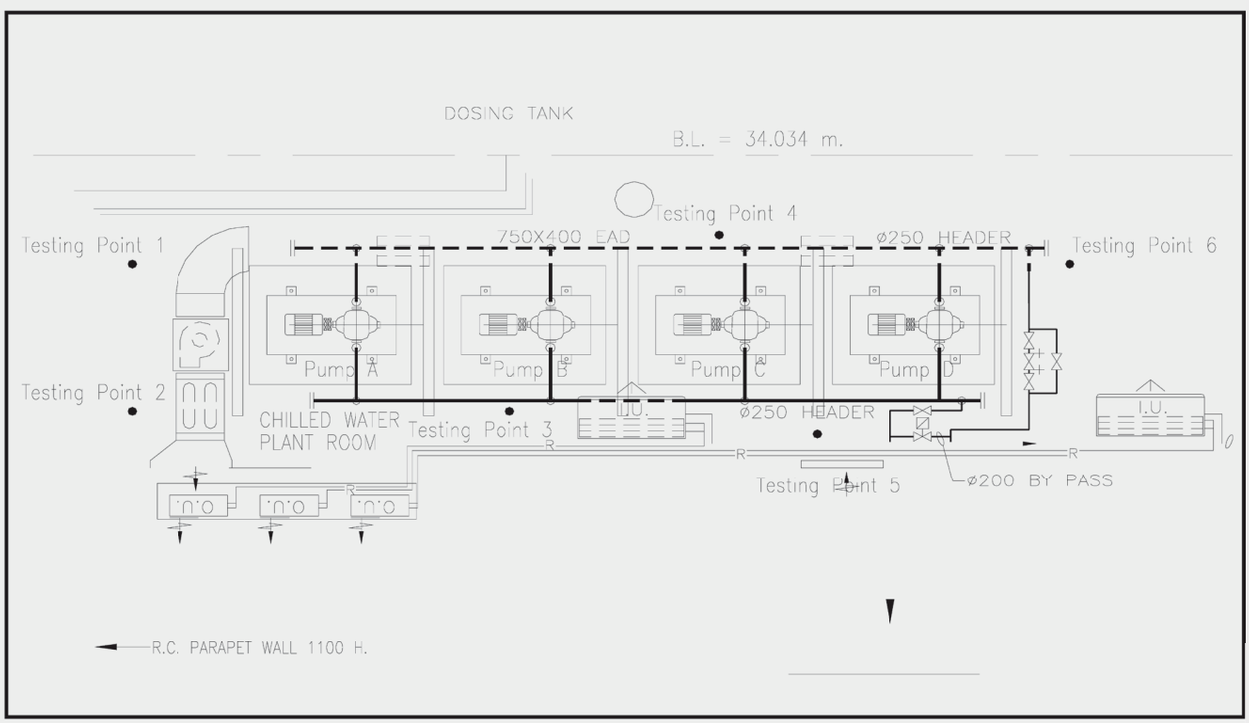
Appendix



Appendix I - Roof plan of Cheung Sha Wan 909



Appendix II – Chiller water plant room at R/F of Cheung Sha Wan 909



Appendix III – Testing point and acoustic barrier in Chiller water plant room

低溫管道的保溫材料為什麼會滴水

李煒權

當水氣壓力相等於或高於水氣飽和壓力時，結露便會形成於其溫度較空氣溫度低的表面上。

溫度的高低直接影響水氣飽和壓力，溫度趨向低，水氣飽和壓力趨向低，溫度趨向高，水氣飽和壓力趨向高。

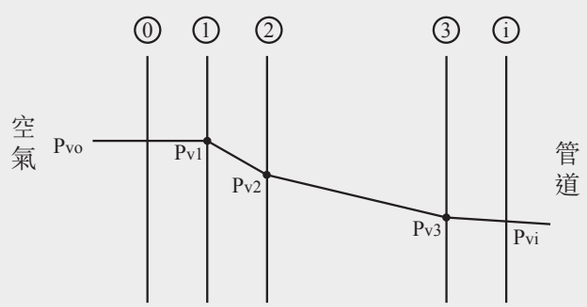
空氣中的含水量也是影響水氣壓力的元素。何為空氣中的含水量？空氣中含有很多水蒸氣，含水量是每千克乾燥空氣中包含多少千克水蒸氣，其單位是 kg/kg 乾燥空氣。

空氣中含水量越高，相對濕度越高，反之，則越低。這正好解釋為何相對濕度高的日子食水喉表面會結了很多水點。因為水氣壓力已相等於或高於與水管表面溫度相應的水氣飽和壓力，也可說水管表面的溫度已低至或低於空氣的露點（Dew Point）。若然將水管加熱，水管表面溫度便會上升，繼而該水氣飽和壓力也上升，但水氣壓力沒有受到加熱的影響，壓力保持不變，水氣飽和壓力便會大於水氣壓力，也即溫度高於空氣的露點（Dew Point）所以結露便會消失。

又為何在相對濕度高的地方或日子，常常會看見包裹運送低溫流體管道保溫材料的表面也會有結露出現？

當保溫材料鋪設在低溫管道上時，在保溫材料的兩面會存在不同的水氣壓力，在與空氣接觸的一面，存在空氣的水氣壓力。在與管道接觸的一面，存在因受管道溫度所影響的水氣壓力。

在大氣壓力下及相對濕度高的情況下，空氣的水氣壓力會比管道那面的水氣壓力為高。而水氣壓力是可透過保溫材料，由高處流向低處，所以由保溫材料的表面到管道表面之間的一段距離，保溫材料內存在著不同的水氣壓力P_v（P_a 或 cmbtg），如圖（1）



⓪ — ①：空氣與鋁箔之間的空氣熱傳導效能
① — ②：鋁箔
② — ③：保溫材料
③ — ㄑ：保溫材料與管道外壁之間空氣的熱傳導效能

$P_{v0} = P_{v1} \geqq P_{v2} \geqq P_{v3} = P_{vi}$

P_{v0} 為空氣中的水氣壓力

P_{v1} 為空氣與鋁箔外面間的水氣壓力

P_{v2} 為鋁箔內面與保溫材料外面間的水氣壓力

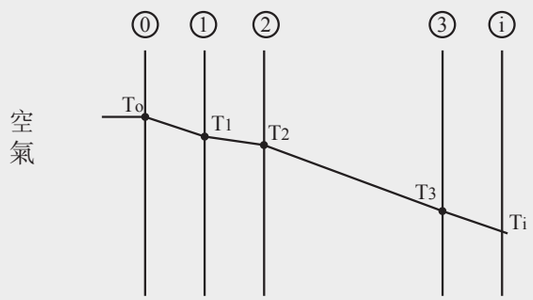
P_{v3} 為保溫材料內面與空氣間的水氣壓力

P_{vi} 為管道面面的水氣壓力

因為鋁箔和保溫材料都會有一定的滲透力

（permeability 或 Moisture vapour Transmission 或滲透效能 permeance Coefficient）。空氣中的水氣會借助壓力的差距，而由外間向管道流入，並在保溫材料內不同的層面形成水氣壓力，因保溫材料的厚度及各層面的滲透能力不一，在不同的層面有不同的水氣壓力，在一般情況下，越接近管道的層面的水氣壓力會越低。

空氣的溫度亦是高於管道的溫度，由於熱流（Heat Flow）也是由高向低流，由保溫材料的表面到管道表面之間的一段距離，保溫材料內存在著不同的溫度T（℃），如圖（2）



$T_0 > T_1 \geqq T_2 > T_3 > T_i$
T_0 為空氣乾球溫度
T_1 為空氣與鋁箔外面間的乾球溫度
T_2 為鋁箔內面與保溫材料外面間的乾球溫度
T_3 為保溫材料內面與空氣間的乾球溫度
T_i 為管道表面的乾球溫度

若然保溫材料的厚道不足夠或是保溫材料熱傳導係數（conductivify）不夠低，熱流便會迅速向管道方向流，繼而令到溫度T1，T2，T3下降，只要任何一點的溫度等於或低於露點，便會有結露形式。

溫度T_1，T_2，T_3，T_i 均會產生相應的水氣飽和壓力。P_{S1} ，P_{S2} ，P_{S3}，P_{Si}。

若果水氣壓力（P_v）相等或大於水氣飽和壓力（P_S）結露便會出現。

若$P_{V1} \geqq P_{S1}$，結露便會在鋁箔外面出現。

若$P_{V2} \geqq P_{S2}$，結露便會在鋁箔內面與保溫材料外面間出現。

若$P_{V3} \geqq P_{S3}$，結露便會在保溫材料內面出現。

若$P_{Vi} \geqq P_{Si}$，結露便會在管道表面出現。

上述第二項至第四項之現象，稱為隱藏結露（Cencealed Condensation）。因為香港夏天的空調設計外圍溫度是乾球33.5℃及相對濕度75%，若在某些日子相對濕度高於設計的相對濕度，便有可能有結露產生，若然管道的溫度變低，也會有結露的可能。若是要避免結露形成，可採取下列改良方案：

1. 選擇滲透能力較低的保溫材料，如：
   ——有鋁箔在外圍的保溫材料；
   ——較厚的鋁箔外圍；
   ——較低吸水性的保溫材料；

這樣便可使保溫材料內的水氣壓力減低，使其不會等於或高於水氣飽和壓力，但這方法的效益不太高。

2. 選擇保溫效能較高的保溫材料，如：
   ——增加保溫材料的厚度；
   ——選擇熱傳導系數較低的保溫材料。

這樣便可使保溫材料內的溫度較接近外邊空氣的溫度，繼而使水氣飽和壓力提升。只要水氣飽和壓力大於水氣壓力，結露便不會出現。這方法的效益較前者的高很多。故建議採用此方案。

當然，除了上述理論性的預防結露方案，在實際上，保溫材料的施工質素；也是重要的一環，如：

——保溫材料的接口是否夠緊貼，以防止空氣的遁入；

——保溫材料的接口有否用鋁箔密封，以減低水氣壓力；

——保溫材料與管道表面有否塗上膠水，使保溫材料緊貼管道表面，以減低 空氣的存在。

若然，保溫材料要應付在外間較高的相對濕度或較低的管導溫度。可在選擇保溫材料前，先進行計算，從而選擇合適的保溫材料。

充電池及其充電器淺談

機電工程署學徒協會　馮劍雲

近日手提電話電池及其充電器意外頻生，包括電池爆炸，充電器過熱引起火警，甚至因漏電而引致人命傷亡。現時市面上一般使用的充電池有：鎳鎘電池（NiCd）、鎳氫電池（NiMH）、鋰離子電池（Li-ion），及鋰聚合物電池（Li-Polymer）。本文主要介紹手提電話較普遍採用的鋰電池（包括鋰離子電池及鋰聚合物電池）及其充電器。希望各讀者多加留意其危險的地方，減少意外發生。

充電池

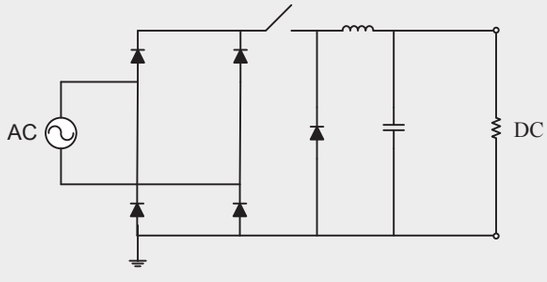
鋰離子電池在製造時使用了鋰鹽（lithium salt）做為電解液（electrolyte），鋰鹽是一種有機溶劑（organic solvent）。由於有機溶劑是處於液體的型態，在製造、儲存或運送時，均要妥善處理，以避免極性反轉（polarity reversal）、電壓超額（over-voltage）、或過熱（overheating）等問題的發生。

鋰聚合物電池中的電解物質並不具備有機溶劑特性，是截然不同的膠狀聚合物。這種惰性聚合物化合物令其可能爆裂的程度遠遠小於鋰離子電池。基本上鋰離子與鋰聚合物電池兩者間的化學反應模式及其放電與充電特性也幾乎相同，因此他們的保護電路與充電電路設計差不多也可以原封不動地互用。

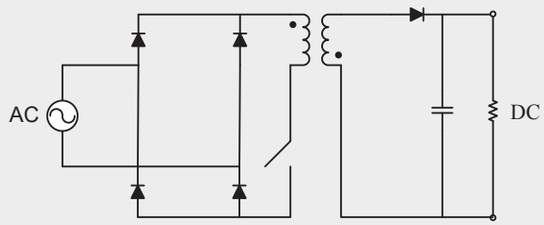
充電器

充電器主要由兩部分組成：降壓電路及換流器。

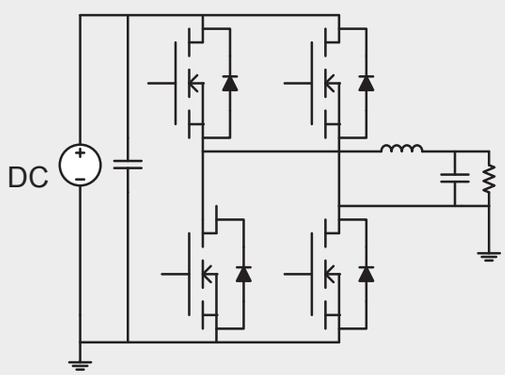
降壓電路可分為非隔離型與隔離型。非隔離型降壓電路因主動開關與輸入串聯，輸入電流為不連續性，不易直接使用電流控制，因此較難達到類似弦波電流。且功率開關須隔離驅動，使電路多出額外成本。



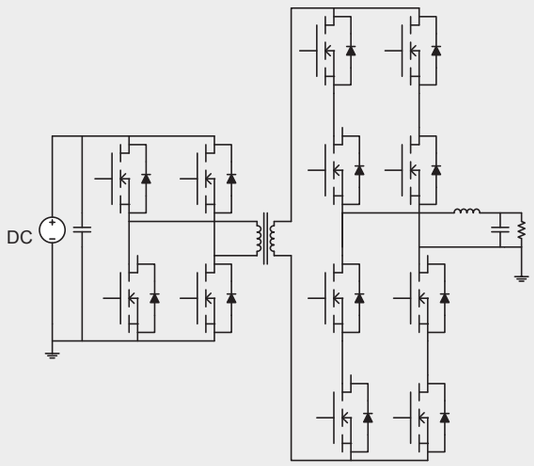
隔離型電路具有更高的調節度與電氣隔離功能，但電路所能操作的功率範圍較小。



換流器亦可分為非隔離型與隔離型。非隔離型換流器主要有半橋式和全橋式兩種。半橋式已漸漸被全橋式取代，此電路透過 PWM 控制得到低頻交流弦波，達到交流轉直流功能，雖有着簡單、體積較小的優點，但卻缺少變壓器作昇降壓的調變自由度。由於直流跟交流側缺少了變壓器的電氣隔離，電路故障時，容易造成較大的損害。需配合有隔離功能的降壓電路。

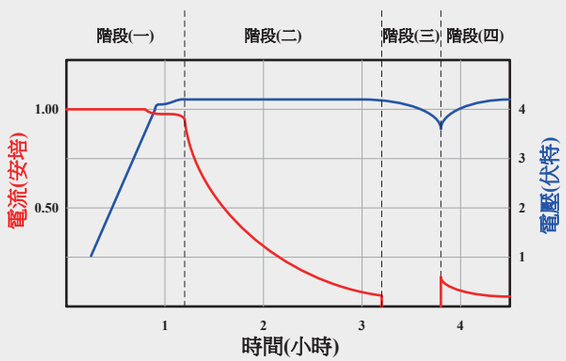


隔離型換流器直流側除了半橋式與全橋式，還有推挽式結構。為了達到交流轉直流的功能，許多電路採用全橋式結構，但全橋式結構相位移控制非常複雜，開關也需要額外電路作隔離驅動，在驅動電路及開關個數上都須付出較高的成本。全橋式雖較雙向開關式少一組感應繞組，但卻需要八個功率開關，如下圖所示。由於電路有隔離裝置，可配合任何降壓電路，效能及安全都較隱定，但成本較高。



充電程序

下圖所示為一般充電器電壓和電流通過充電時各階段的變化。



在第 1 階段（恆流階段），充電器對電池作恆流式充電，增加充電電流不太多時，充電速度會迅速填補電池約 70% 的總容量。充電速率若在 0.5 至 1C 之間，電池電壓會隨充電時間而增加。電池充電效率為 97% 至 99%，由於鋰離子電池的保護電路和/或內部電阻會升高，使電池的溫度約上升 5˚C，因此在充電過程中電池應保持涼爽。

在第 2 階段（飽和階段），電壓已接近設計電壓，充電器與電池的電壓差漸漸減少，令充電電流減低，當電流降低至額定值若 3% 時，電池

被認為完全充電，充電器會對電池暫停供電而進入階段 (3)。

在第 3 階段（運行階段），當充電器暫停對電池，一旦充電結束，電池電壓開始下降，隨著時間的推移，開路電壓將回落到 3.60V 至 3.90V 之間。

在第 4 階段（補充階段），當電壓回落到某預設值時，充電器會對電池作補充充電。

潛在危險

鋰離子電池不能接受過度充電的。一些成本較低的充電器簡化充電程序，沒有進入第二階段飽和充電方法充電，令鋰離子電池在一小時或更少時間充電就緒。用較高的電壓充電，雖可增加容量，但導致電池氧化而減少使用壽命，更重要的是會令電池過熱而引致火警或爆炸。因此適當的鋰離子（Li-ion）電池充電器應有一個電壓限制裝置。

在指定的工作電壓內充電，鋰離子電池都能安全地正常充電，否則電池變得不穩定，電池內壓上升，一般負責電池安全斷開電流的電流中斷器件在約 1380 千帕（200PSI）開斷電路。若電流中斷器件未能開斷電路，而壓力進一步的上升，在約 3450 千帕（500PSI）安全膜可能會裂開並洩出火焰，引致火災。

鋰離子電池並不需要完全充電，事實上最好不要完全充電，因為高電壓會損壞電池。選擇不完全飽和充電，能延長電池壽命，但卻降低了運行時間。一般消費者都只著重較長的運行時間，忽略電池的使用壽命。

某些便攜式充電器可以同時向多個設備充電，多個負載同時充電可以扭曲電池的充電週期。當其中一個設備的電池已完全充電，而其他仍未完成充電，條件提示仍要充電，這會導致不必要的電池應力和協調的安全問題。

若使用者選用原廠或合規格的電池和充電器，及注意使用安全，發生意外的機會將大大降低。

參考文獻

[1] http://pdt.acesuppliers.com/meg/meg_1_80689111200612511646276 02_7521.html

[2] http://www.fairchildsemi.com/ds/FA/FAN5400.pdf

[3] http://ccur.lib.ccu.edu.tw/retrieve/1370/097CCU05442081-001.pdf

上鎖掛牌制度

職業安全健康局

進行機電設備維修時，若沒有將電源關上，可發生「觸及開動中機器」或「觸電或接觸放出的電流」等意外。實施「大掣」上鎖掛牌制度是進行停機時維修保養工作的安全施工程序。這程序可確保員工在維修或檢查機器時，機器設備不會突然啟動而傷及正在維修的員工。

上鎖掛牌制度

一. 關上大掣及上鎖

機器設備的電源必須隔離（如關掉相應的開關掣或斷路器）並上鎖。

員工所用的掛鎖須配以獨立鎖匙，即不可使用一匙配多鎖。鎖匙須妥為保管。

若超過一個員工在使用或維修同一部機器設備時，則每名員工都須在該電氣裝置上加上自己的掛鎖。供集體上鎖用的鎖牌必須適合多把鎖一同使用。

二. 掛牌

將危險警告牌掛於已鎖上的開關按鈕上，以警惕其他人士不可干擾該電源。

掛牌中的內容必須簡潔清晰，應包括掛牌的日期/時間及上鎖人的資料。

三. 確保於無能量狀態

未正式對電氣裝置進行工作之前，應採用電壓顯示器、儀表或其他適當設備，確認該裝置已不帶電。

中小型企業上鎖掛牌套裝資助計劃

為改善機電設備維修從業員的工作安全，職業安全健康局推出「中小型企業上鎖掛牌套裝資助計劃」，資助購買上鎖掛牌設備。上鎖掛牌套件是一套給電氣技工為電氣裝置進行維修、保養工作時使用的安全裝備，用作隔離電氣能源，如電氣開關、斷路器或電氣插頭等；並使用掛牌來警告別人該電氣裝置的電源已經被上鎖及不准操作。這個計劃會津貼中小企業購買上鎖掛牌套裝，上限為港幣 800 元。

如欲索取更多有關資助計劃的資料，請致電 2116 5675（郭小姐）或 3106 5786（周小姐）查詢，或瀏覽以下網址：http://www.oshc.org.hk/download/company/SME_Lockoutscheme_form.pdf 。

香港建造及裝修工程從業員協會　行業資訊

編者按：香港建造及裝修工程從業員協會剛於 2013 年 7 月 19 日舉辦了慶祝師傅誕暨協會成立十周年聯歡聚餐！

協會自成立以來，一直秉承傳統組織會員及從業員們慶祝師傅誕，藉紀念魯班先師凝聚行家。紀念先師不但肯定其神乎其技的成就，更定了「規」和「矩」，也就是丈量和畫線的工具，最後衍化成為人的處世標準之意。中港台三地都有不同的先師廟俾業者及善信供奉，協會藉《今日機電》刊物轉載三地關於先師廟的介紹，宣揚魯班先師精神！

（以下轉載百度百科關於天津薊縣魯班廟的介紹）

天津薊縣魯班廟

魯班廟位於天津薊縣城區中心的「鼓樓」北側、薊縣一中西南側，這是古代奉祀土木工匠祖師魯班的地方，現為市級文物保護單位。現在魯班廟內供奉著魯班及其四位弟子的塑像。

魯班廟，占地 840 平方米，建築面積 341 平方米，清代宮式建築，以工精料實、彩繪精美著稱於世。它由山門、正殿、配殿、平房組成。山門面闊三間，進深兩間，在明間的正中設有板門和抱鼓石，次間採用了大式硬山頂和外簷護封裝飾。主體建築大殿面闊三間，進深一間，前面出廊，在明間採用了菱花格門和隔扇窗。大殿使用了鐵糙木，這種木材比水重，比鐵硬，薊縣本地不出產，應該是皇家用料。建築風格採用了一門三升的建築形式，表達了工匠們對祖師的尊崇。大殿的屋頂採用了歇山頂結構，上覆綠色琉璃瓦。在古代的社會對此有著嚴格的規定，最高等級是廡殿頂，其次是歇山頂。宮制琉璃瓦等級最高，綠色次之。魯班廟的建造者在「不逾規」的前提下，儘量提高建築的規格等級，可謂匠心獨具。廟的內外簷裝飾彩繪，均不瀝粉貼金，而是以青、綠及墨色勾勒。作品紋路清晰，畫風清新。所繪內容以夔龍、錦紋、花鳥等為主，是天津地區明清時期民間彩繪藝術的代表之作。

魯班廟，始建年代不詳。傳說，獨樂寺是因魯班顯聖而建，古代薊州人為了紀念魯班，在這裡建廟供奉。清朝康熙、乾隆、光緒年間三次重修。有專家認為，清初在遵化修建康熙、乾隆陵時，工匠們節省了一些木料、磚瓦，在薊縣重修魯班廟，以求祖師庇護。此說法已在廟內尚存

的碑刻《重修公輸子廟碑記》（清光緒三年）得到旁證。碑載：「東陵吉地，在薊城南蔡莊賃地數十畝作木廠。眾匠人曾到魯班廟謁廟焚香，自興工至今一切平安，皆仰祖師默佑。產生重修之願。會同本郡鄉紳，各廠算房（帳房），樣式房（設計模型單位），各作匠，出資共成善舉。」現場核查，這座建築是嚴格按照官式作法修建的。大殿木柱用的是鐵糙木，此不比水重，較鐵硬，薊縣本地不出產，可能是皇家用料。木框架使用斗拱，在古代建築中稱大式作法，民間是不能使用的。因多年來整個建築被學校站用，沒遭大的破壞，1986 年，市文物部門除按原樣整修油飾之外，儘量保持原樣，使其有古建特色，並在大殿請該縣泥塑專家于慶成重塑了魯班像和四位弟子像，在中國久遠的歷史中，魯班已是眾多能工巧匠的代表，勞動人民聰明才智的化身。薊縣魯班廟的大殿，重塑了魯班坐像，面貌和善，身著布衣，並塑木、瓦匠兩弟子像，弟子手拿曲尺和線盒等工具，並在配殿中佈置了魯班生平事蹟展覽。

魯班發明了木工用的直角尺和鋸、刨、鏟、鑽等工具，首先鑿出了加工糧食的石磨，還造了木人駕駛的馬車，能飛上天空、三日不落的木鳥。因此，被建築業稱為祖師爺，歷代不少地方都為他修廟塑像，受到了神一樣的尊敬。

魯班廟不屬佛，不屬道，是個民間行業廟宇，平時很少香火。只有到了每年農曆五月初七，魯班的祭祀之日，才熱鬧一番。這一天，全城木工、泥瓦工、石匠、鐵匠架子工、席箔匠、油漆匠、裱糊匠等一切與建築有關行業的手工業工人，都要自動休假，穿戴整齊，早早來到廟內，互相道辛苦問好，上供、焚香，參拜「祖師」，舉行祭祀活動。這是一般年份情況，如遇風調雨順、比較太平的年月，除祭祀之外，還要舉行慶祝和聯歡活動。一位生於清末現已過世的老油漆彩畫工曾對筆者說過，民國初年到抗戰前一段時間，年景較好，五行八作收入比較穩定，幾乎每年都舉行隆重的慶祝活動。所謂隆重，就是在「參拜敬祖」之外，舉行集體的「收徒拜師」儀式。而後大擺酒席，開懷暢飲，並進行聯歡，能拉的拉，能吹的吹，能唱的唱。慶祝活動由臨時推舉出來的班子負責籌備，費用完全由各行各業工作自願捐助。

後記：

香港建造及裝修工程從業員協會於 2013 年 7 月 19 日舉辦了慶祝師傅誕暨協會成立十周年聯歡聚餐，筵開 7 席。活動得到職業性失聰補償管理局贊助，並邀請到註冊安全主任王思敬先生，主講『預防職業性失聰』職安講座。在此，特向職業性失聰補償管理局表示感謝，及向王思敬先生致謝。

理事長為大會獻詞

慶祝協會成立十周年暨師傅誕聯歡聚餐，理事們拍照留念。

康樂主任及會務主任進行填字遊戲環節

邀請註冊安全主任，主講『預防職業性失聰』職安講座

一個電業工程人員與香港之政治

物業維修員

在香港，大部份電業工程人員對政治比較冷感。一來作為社會的中下階層，向政府之議價能力不高。二來近年工程暢旺，每天之精力已經差不多全用在工作上，何來餘閒！講得通俗些：「有時間搵錢好過啦！何況百物騰貴，一個早餐及午餐分別接近30及50元，再加上昂貴的交通費，每天最低消費都要一百元以上；又要養妻活兒。談政治不如談幾時加人工。」

就我所服務的一座樓宇為例，地下為商舖，一至三樓為商場，四樓以上為住宅單位，實在是香港的縮影，何解呢？地舖的人數最少，但業權份數最多，享有最大的話事權，但管理費卻不與業權份數掛鈎，按面積計算管理費，再另加冷氣費，雖然單一的管理費最多，但整體所佔之的管理費比例卻不高。至於商場，總業權份數及整體管理費與樓上住戶差不多。形成三分天下的局面，這三者就好像社會上高，中，低的三個階層。

首先，商場之電力供應非常緊張，地舖之電力卻非常充裕。由於大廈由1隻1500kVA之變壓器供電，只有2279A之供電量(1500/0.38x1.7321)，地舖，商場及住戶分別代表三個不同的集團，爭奪有限之電力資源。作為既得利益者，地舖不願意將多餘之電力與商場分享。另一方面，管理公司的角色有些像政府，既要平衡各利益集團，又要運用有限之資源去處理無限量之工作。吃力不討好！自從1997年代替另一家管理公司接手大廈之管理工作後，便一直處於弱勢，不斷被法團挑剔及指責。相比1997年前，上一手之管理公司由於是發展商之附屬公司，由入伙紙起計有10年之專營權，所以地位超然，不能轉換管理公司。因此每呎之管理費非常高昂。但當然，作為上市公司，收費較高但提供較優質服務亦無可厚非。當時由於樓齡較短，要維修之項目不多，舊有管理公司又採用懷柔政策去打動不同之利益集團，業主立案法團亦未成立，只有由管理公司協助成立的業主委員會。所以大廈各商住戶均不熱心大廈之管理工作。直到臨近1997前數年，權力才逐步下放，協助成立法團，至此大廈才真正自己當家作主。不過，現時之管理公司不斷地被人指責，相信有機會下台，由另一管理公司接手！但法團由於從三方面組成，各自代表不同利益，所有對大廈影響深遠的議題全部未能通過。大廈外觀越來越殘舊，近這十多年毫無建樹，只是不斷內耗，使到商舖的人流下降，龍頭地位被附近的商場取代。

最近，由於垃圾的處理令大廈引起爭議，每個單位都不想垃圾臨時存放的位置處於自己附近，只是高呼要環保及從源頭上減少廢物之產生。更強調若無一套完整的藍圖，是不會通過任何決議！但廢物每天都會產生，改變住戶之環保思維又不是一朝一夕的事。若再爭議下去，後果

嚴重。

再者，禍不單行地，大廈又收到機電工程署的信件，要求大廈進行能源審計，法團由於座擁大量的儲備，原本想一併為大廈之機電設備更新，轉用一些更有能源效益之產品。原本這是好事，為香港以至整個地球村的環境保護盡上一分力量，可惜這些好事卻因一些政客的加入而弄得一團糟！正如上文所說，大廈有不同的利益集團，二批政客為着日後之選票，分別加入了不同陣形。樓上住戶要求將所有升降機系統轉用VVVF(Variable Voltage & Variable Frequency)，商場及地舖要求將冷氣系統轉為熱泵式(Heat Pump Type)。由於二者都所費不菲，但又代表自身的利益，故雙方面都極力爭取。結果為平衡兩方面，法團唯有大灑金錢，二項工程都一併進行。但卻將一些原本打算更換為LED光管的公眾照明全部取消，這些項目工程費較低，但回本期很快，按照原有預算只需9個月便可回本，放棄了實在可惜！

由於工程龐大及全部同時進行，管理公司推卻協助監管，要求大廈引入外勞(另行聘請顧問公司)，經過數月來的工程，最近終於完工。但結果出來，VVVF之升降機系統之節能成效遠遜預期，估計要20年才可回本，並且因為該電子系統抵受不了香港炎熱及潮濕的天氣，經常損壞，結果升降機房要安裝冷氣，最終得不償失。

至於商場及地舖的熱泵式冷氣，製造了大量熱水，因為商業單位不需熱水，原本期望樓上之住戶能接收熱水，達到雙贏的局面。但因需另外安裝熱水喉供應樓上單位，故需向個別要熱水供應之住戶收費，結果乏人問津，最終每天要排走大量的熱水，雙贏變成雙輸！

註：以上故事純屬虛構，如有雷同，實屬巧合。而作者之言論並非代表編輯的立場。

衝上四川的雲霄　機電聯會國情研習班

香港安全督導員協會　總幹事 譚金蓮

今年的五月中，筆者有幸代表香港安全督導員協會參與機電聯及勞聯舉辦的國情研習班往四川進行考察，行程包括到訪2008年汶川大地震震央遺址，考察四川三千年前高度文明的金沙遺址，參觀成都航天工程及發電製造廠等等，當中最大感受的是參觀兩所機電工程相關的工廠，這類重工業不僅是香港所沒有的，更非一般尋常易見的重工業，當然行程不會看到最新的殲二十戰鬥機，但能得到已多年不接受訪問團的核心工業接待，並讓我們機電聯代表一窺工程的部份工序，加上機構為本團特別提高規格，安排資深工程人員陪同參觀及講解，整個行程不僅是眼界大開，更加拓闊視野。

研習班出發前一個月，四川再發生七級大地震，令筆者在出發前的心情除了探索新事物的期盼，

亦再帶多一份肅穆，實在是百感交集。但打從雙腳踏上四川土地的一刻，接觸到感受到的氣氛並不是肅清悲傷，更多的是積極正面努力地生活下去！五年前地震震央的映秀鎮人民早已重投生產，積極地生活，就像四川航天及發電機工程一樣，以無比的毅力和努力編寫自己的生命。願與各位共勉之！

港九電器工程電業器材職工會　energy INSTITUTE HONG KONG　香港機電業管理及專業人員協會

聯合舉辦

建築物能源審計檢測員培訓課程

課程目標：讓學員認識基本的建築物能源審計知識，以及掌握審計儀器的運用技巧及實務技能，日後可協助註冊能源審計師的實務檢測工作。

上課地點： 旺角廣東道 982 號嘉富商業中心 3/F

課程對象： 現職電機、屋宇設備、機械及能源等相關工作，並有意擔任能源審計檢測工作的人士。

課程內容： 建築物能源效益條例簡介、能源審計概覽、節能成效的測量和核證方法、冷暖及通風空調系統(HVAC)、能源審核（冷暖及通風空調系統）儀器的運用技巧及實務技能、照明系統、能源審核（照明系統）儀器的運用技巧及實務技能、配電系統及電力效能提升、能源審核（配電系統及電力）儀器的運用技巧及實務技能、升降機及自動梯系統、能源審核（升降機及自動梯系統）儀器的運用技巧及實務技能等。

入讀資格： 相關文憑 (電機，屋宇設備，機械，能源，等)；及中五程度並持有註冊電業工程人員註冊證明書。

費　　用： 合辦或協辦機構會員：1,500 元　非會員：2,000 元　(包茶點)

證　　書： 出席率達百分之七十五或以上，將獲發出席證書

報名辦法： 填妥報名表格，以郵寄方式將報名表格連同支票寄往：廣東道 982 號嘉富商業中心 3/F（支票抬頭「港九電器工程電業器材職工會」），並致電 2393 9955 或 2626 1927 預先留位，或親到本會辦理報名手續均可。

報名及查詢電話： 2393 9955 / 2626 1927

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