IMC 2012 Changes Affecting Parking Garage Exhaust Systems Implementation

Rev 1.0

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1 Introduction

Stand by for some monumental changes to the International Mechanical Code. IMC 2012 is due for release on April 30, 2011. Before we delve into the approved changes to the code, we need to understand who develops the code and why it is important to us. Once we establish the proper perspective on the IMC authors, we need to look at adoption of these codes locally. Although the code is changing, it does not mean that your local authorities will adopt it in the near future. In my evaluation of the Texas parking garage market, I found versions of the IMC code dating back to the year 2000. Due to the wide array of mechanical codes nationally, I will illustrate the evolution of the code and its effect on parking garage design considerations. Finally I will reveal the changes due for release on April 30, 2011 so that we can understand how to effectively incorporate them into our design parameters.

2 Mechanical Code Expert Authority – *The International Code Council*

The International Mechanical Code (IMC) is developed by the International Code Council (ICC). "The International Code Council (ICC) was established in 1994 as a non-profit organization dedicated to developing a single set of comprehensive and coordinated national model construction codes. The founders of the ICC are Building Officials and Code Administrators International, Inc. (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International, Inc. (SBCCI). Since the early part of the last century, these non-profit organizations developed three separate sets of model codes used throughout the United States. Although regional code development has been effective and responsive to our country's needs, the time came for a single set of codes. The nation's three model code groups responded by creating the International Code Council and by developing codes without regional limitations; the International Codes" (ICCsafe.org). Consequently, the International Mechanical Code is widely accepted as the authority defining industry "best practices."

3 Local Code Adoption Process

While the ICC develops comprehensive construction codes, it is up to each local municipality to adopt, enact and ultimately administer them locally. The burden of administrating each code is quite a formidable task. Significant resources are expended on inspectors, plan reviewers and support staff. Unfortunately the process of reworking the local codes to incorporate recommended changes set forth by the ICC is a burden added to departments that are typically stretched thin. The proposed changes must be reviewed and their applicability to the local markets must be evaluated. If the proposed changes to the code are deemed warranted by the city managers, the proposed changes are typically brought to the city council for a vote. If approved, the changes will be written into the local code after training is developed and executed to ensure city code enforcers and plan reviewers are aware of the impact of the changes. This is quite a burdensome process and it exhausts significant resources in its execution. The proposed changes must be seen by the local officials as a value added proposition as they weigh the time and effort of implementing these changes. It is no wonder why some cities are using code developed in the year 2000.

4 Variances

The resultant lag in code adoption at the municipality level places the burden of liability on any engineer wishing to incorporate newer code features into their design. While each engineer is required to add his seal of approval on all project drawings, it stands to reason why some would prefer to relent to the status quo vice push for the implementation of new standards due to the risk of liability. A variance can be issued if there is sufficient documentation validating the need for the change but each municipality will hold the project documents on file. If an event occurs that would have been covered by the code circumvented by a variance, the liability for this event falls to the engineer of record. I have yet to find a code enforcement official willing to put their neck on the line to implement even the best design changes.

5 Tracking the IMC Evolution

The following excerpts are from the 2003-2012 IMC's. Section 404 titled "Enclosed Parking Garages" is the only relevant section to this discussion. The bulleted points are commentary inserted for clarification purposes and are designed to simplify the specific portions of the code applicable to gas detection and ventilation rates.

5.1 2003 International Mechanical Code

*"**404.1 Enclosed Parking Garages**. Mechanical ventilation systems for enclosed parking garages are not required to operate continuously where the system is arranged to operate automatically upon detection of a concentration of carbon monoxide of 25 parts per million by approved automatic detection devices." (IMC, 2003)*

- CO detection with a set point of 25 ppm is specifically called out as a means to modulate fans.

*"**404.2 Minimum ventilation**. Automatic operation of the system shall not reduce the ventilation rate below 0.05 cfm per square foot (0.00025 m3/s × m2) of the floor area and the system shall be capable of producing a ventilation rate of 1.5 cfm per square foot (0.0076 m3/s × m2) of floor area." (IMC, 2003)*

- Minimum ventilation rate of 0.05 cfm per square foot required.
- System must be capable of 1.5 cfm per square foot at full speed.

> The "net green impact" here is a +5 in a scale of -5 to +5 since it allows us to scale back exhaust fans when toxic gas levels are safe.

5.2 2006 International Mechanical Code

- This iteration removed the specific provision for Carbon Monoxide.

*"**404.1 Enclosed Parking Garages**. Mechanical ventilation systems for enclosed parking garages shall be permitted to operate intermittently where the system is arranged to operate automatically upon detection of vehicle operation or the presence of occupants by approved automatic detection devices." (IMC, 2006)*

- The insinuation inherent here is that the system would be controlled using motion sensors.
- Some local officials such as the City of Dallas interprets this to mean that if carbon monoxide detection is engineered into the job and the detectors are on the prints that are approved by the city, then this becomes an "approved detection device".
- No guidance is given to determine set-points, it is up to the engineer of record and he is held liable if there is a problem.

> The "net green impact" here is a -5 in a scale of -5 to +5 since it removed the provision for gas detection as a means to allow us to scale back exhaust fans when toxic gas levels are safe. The "motion sensor" application was never widely accepted nationally as an acceptable means to modulate exhaust fans.

5.3 2009 International Mechanical Code

- Did not change section 404.1.

*"**404.2 Minimum ventilation.** Automatic operation of the system shall not reduce the ventilation rate below 0.05 cfm per square foot (0.00025 m3/s × m2) of the floor area and the system shall be capable of producing a ventilation rate of <u>0.75 cfm</u> per square foot (0.0076 m3/s × m2) of floor area." (IMC, 2009)*

- 2009 reduced the required system capability in half. It went from 1.5 cfm per square foot to 0.75 cfm per square foot. This is substantial since it allows engineers to decrease the size of the exhaust fans and saves cost of ownership to garage owners.

> The "net green impact" here is a +2 in a scale of -5 to +5 since it allowed designers to decrease the size of fan systems which ultimately saves energy and decreases costs to building owners in both initial construction and ongoing operations.

5.4 2012 International Mechanical Code

- The following excerpt is listed under M28-0910 in the Tentative Order of Discussion for the Mechanical Code Committee of the International Code Council. It was advocated by Larry Lincoln representing the Utah Chapter of ICC.

*"**404.1 Enclosed parking garages**. Mechanical ventilation systems for enclosed parking garages shall be permitted to operate intermittently in accordance with Item 1, Item 2, or both, where*

1. The system is shall be arranged to operate automatically upon detection of vehicle operation or the presence of occupants by approved automatic detection devices.

2. The system shall be arranged to operate automatically by means of carbon monoxide detectors applied in conjunction with nitrogen dioxide detectors. Such detectors shall be installed in accordance with their manufacturers' recommendations.

***Reason:** Our experience on the last several projects is that the operation of motion sensors in parking garages is very costly and energy inefficient. Initially the code just required carbon monoxide detectors and there was a concern about diesel emissions that could not be detected by the carbon monoxide detectors. Since that time, nitrogen dioxide detectors have been developed which will detect diesel emissions solving the concern about the increase of diesel powered vehicles in parking garages. Using both detectors has been the preferred option as an alternate method of addressing the problem.*

***Cost Impact**: Less overall expenses in power bills." (ICCsafe.org, 2010)*

- This change is significant. For the first time ever, nitrogen dioxide in addition to carbon monoxide detection is called out specifically as a proper means to operate parking garage ventilation systems automatically. The resultant system infrastructure provides superior protection against toxic gas buildup in enclosed parking structures while reducing energy consumption.

> The "net green impact" here is a +5 in a scale of -5 to +5 since it couples CO detection with NO_2 detection to allow us to scale back exhaust fans when toxic gas levels are safe.

6 IMC Summary 2003 – 2012

How the International Mechanical Code effects parking garage exhaust systems implementation:

- **IMC 2003** specifically called out carbon monoxide detection as a valid means to modulate exhaust fans to keep inhabitants safe while conserving energy.
- **IMC 2006** removed the provision identifying CO detection and replaced it with verbiage relating to the use of motion sensors to detect pedestrians or the operation of vehicles.

Motion sensors do not take into account someone idling in their vehicles for an extended period of time. If the motion sensor timed out then the gas levels would rise in the garage since the fans would scale back. Once a pedestrian entered the garage, there was a potentially bad situation occurring.

CO detectors do not take into account diesel fumes that are hazardous to our health as well.

The verbiage "approved detection devices" is also present in the code and is being used by some municipalities as a means to add CO detection back into the mix. As long as the CO detectors are on the plans, many plan reviewers will allow CO detection but puts the onus on the engineer of record for the recommendation of these "approved detection devices".

- **IMC 2009** decreased the required ventilation capacity from 1.5 cfm per square to 0.75 cfm per square foot.
    - This is significant since it allows engineers to reduce fan sizes. These smaller fans use less energy and are more cost effective to the owner both in the short and long term.
- **IMC 2012** adds CO coupled with NO_2 detection as a viable demand based exhaust ventilation control strategy for enclosed parking structures.

<u>The use of CO detection coupled with NO_2 detection is the new standard for demand based exhaust ventilation control in parking structures.</u>

IMC 2012 will hit the streets on April 30, 2011. The changes to IMC 2009 for release in IMC 2012 can be viewed at http://www.iccsafe.org/cs/codes/Documents/2009-10cycle/ProposedChanges/IMC.pdf

7 Energy Cost & Greenhouse Savings and Return on Investment

The table below illustrates the carbon impact of demand control exhaust ventilation on a typical 350-space parking garage.

Underground Garage/Parking Structure of an Office Building **- 100,000 sq ft** for about **350 parking spaces** for automobiles **-** Approximately total **75 HP** (Horsepower), combined of all fans **-** 12 hours/day and 7 days/week garage operation		
HP (Horsepower) **to Watts** (Electrical Power) **Conversion** *(In this example the fan motor efficiency and load factor canceling out each other)* **75 HP** x **746 Watts**/HP = 55,950 Watts divided by 1,000 = **55.95 kWatts**		
Annual Fan Power Consumption (kWh)	**Without** Gas Detection Demand Control **12** hours/day x **365** days x **55.95** kWatts = **245,061 kWh**	
	With Gas Detection Demand Control **2** hours/day x **365** days x **55.95** kWatts = **40,844 kWh**	
Annual Savings	**kWh Savings per Year:** No Demand Control 245,061 kWh Demand Control - 40,844 kWh Savings = **204,217 kWh**	**Electricity Cost Savings per Year:** 204,217 kWh x **$ 0.175** per 1 kWh Savings = **$ 35,738**
- Installation Cost - **Return of Investment**	With Utility Rebate	**Immediate** to **0.5 Year**
	(No Rebate)	**0.8** to **1.5 Year**
Greenhouse Savings	273,651 lbs CO_2	

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