Using BIM for Futuristic Workplace Safety and Permit-to-Work System for Hot Work

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Abstract

A permit to work is used equally in the construction and marine industry to begin work that can be hazardous in nature. It specifies the task to be performed, associated foreseeable hazards and the safety measures required.

However, the current permit to work systems lack in their merit of evaluation – that is, they are still dependent on human evaluation. Humans are often prone to errors and this can result in major catastrophes and thereby endanger humans and environment exposed to the accident.

Today, BIM (building information modelling) solutions are widely available. The current paper talks about a methodology to create a self-evaluating permit-to-work system which can monitor hazards proactively and protect workers in an enhanced manner.

Keywords: *Electronic Permitting System, Electronic Dashboard, E-Permit, BIM models, 3D permits*.

1. Introduction

Slowly as industries are moving towards implementing electronic permit to work systems, safety officers and workers are getting comfortable using technology as a means to simplify their work of applying for permits, renewing them and then carrying out activities at the job-site.

One of the usual types of permits applied in the construction and marine industry is permit for hot-work.

The simplicity about hot work permits is – they are more location and positioning dependent rather than being based on a process. Take for example: a place where hot-work can be carried out is a physical place, and whether hot-work can be carried out depends on extent of hot-work and incompatible works nearby. It can be decoded into a set of equations and is largely dependent upon position and location where hot-work is to be carried out. Accidents in these cases are usually not so prone to the personnel carrying out the works. However, for works such as heavy lifting of equipment, it is a process oriented task whereby the operator may falter, thereby causing an accident.

Integrated digital solutions of permit-to-work system can be used in conjunction with BIM technology to provide amazing features including risk assessment, simulations of works being carried out, incompatible works check and evaluation etc.

Diagram 1: Types of Permit to Work
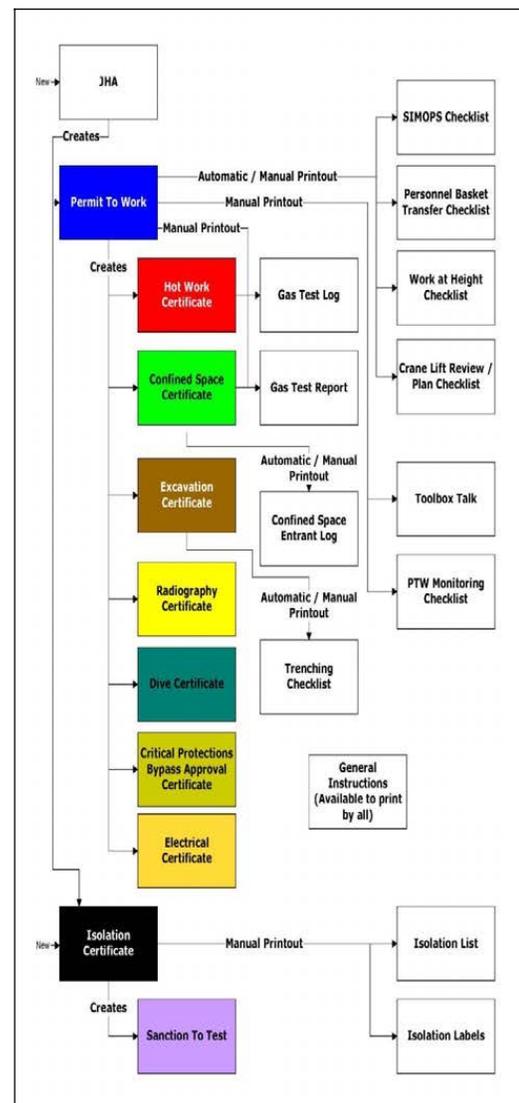
2. Building Information Modelling

Building information modelling is a process involving the generation and management of digital representation of physical and functional characteristics of places.

In short, a complete building information model can be said to assimilate all the critical information that pertains to any construction that is to be carried out.

Diagram 2: A Sample of Building Information Model

A building information model can contain crucial information about where all the fire-prone insulation is present, where all items which contain chemicals are installed, how is the compartmentalization being done, how is the air ventilated.

The way this information is going to be used will be presented in the subsequent sections when we'll use the Building Information Model for applying permits.

3. Hot-Work Permit Requirements

As discussed before, since hot work permits are location dependent, they have very fixed information requirement which can be easy to configure.

The goal is to be able to create flexible rules which can be integrated with the available BIM models and thus use the BIM model directly to apply permits and be able to evaluate them.

Table 1: Hot work Permit Requirements

| Type Of Permit	Requirement	Implication
Hot Work	No Incompatible Work in Nearby Vicinity	1. No item susceptible to fire within a radius of 3-4 meter. 2. No chemical or painting work within same closed compartment 3. No ventilation from other compartments whereby it may contain flammable gases

4. Sampling Requirements into Equations

Hot work Permits:

4.1 The incompatible work must be outside the sphere of influence of hot work if inside the same compartment

When the worker marks the location of hot work inside the BIM model, it can automatically look for other elements nearby and check whether incompatible works are nearby or not.

This is possible using volumetric sphere approach to check that all other incompatible work is far away.

### Diagram 3: Using BIM to determine sphere of influence
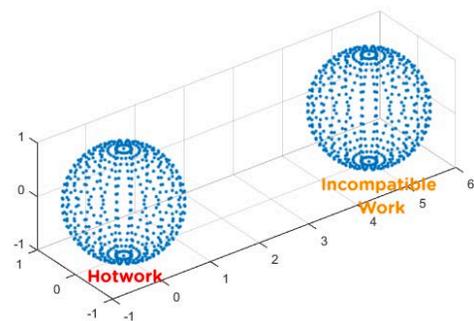
4.2   Any incompatible work in other compartment (for painting or chemical work) should not have any ventilation connected to area of hot work

Since some of the incompatible works are gaseous in nature such as painting and chemical work, it will be

auto-checked in BIM models whether these compartments have interconnected ventilation network.

Diagram 3: Using BIM to determine interconnectivity between compartments
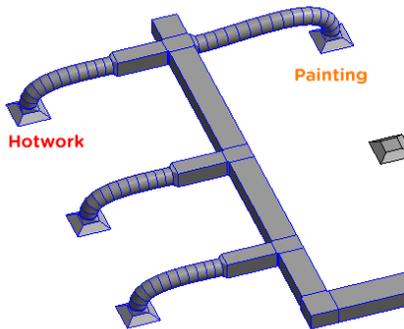
5. Implementation

The implementation involves using BIM models to apply for permit to work.

After application, the permits will be automatically evaluated using the constraints and criteria as mentioned above.

This will create an additional evaluation check beyond the evaluation by safety officers to ensure no permits that may compromise safety are passed.

Diagram 4: Using BIM to apply Permit to Work

6. Challenges

Foreseeable challenges exist in form of computation limitations, information availability and information segregation.

Computation: In order to carry out large amount of computation for these required checks, we require a large amount of computation power. Given availability of cloud computing resources, it'll become possible in the future to host these BIM models on the cloud and using resources such as AWS to carry out these checks.

Information Availability: Every type of information is not available in a BIM model. For example, a recent shift of chemical cans in the compartment is not what is catered for. That is why, it must be understood that human inspection complements this check and is not a substitute for it.

Information Segregation: Using duct structure to find out interconnected compartments, using insulation coverage to find affected areas, or compartment boundaries to determine whether two incompatible works are in same compartment – all these require divisioning and defining all the BIM components in new ways. This is a huge task at first, but once it is done, will yield its expected outcomes.

7. Conclusion

The electronic permit-to-work system with BIM will result in improved permit-to-work administration, quality of job hazards analysis and risk mitigation, authorization rigor, HES competency management, training new person, search and access historical data, monitoring (inspection/audit/review), emergency response etc, thereby supporting work safety.

8. Acknowledgement

9. References

1. Occupational Safety and Health Administration; 29 CFR 1910
2. Safety Permits: A Risk-Management Process of Hazardous Operations (Section # 628) by Manuel B. Dominguez, M.S., CSP, NASA Glenn Research Center Cleveland, Ohio.
3. HSE (2002): Permit-to-work systems (INDG98), Rev3
4. ANSI/ASSE Z117.1-2009 Safety Requirements for Confined Spaces
5. Engica Technology Systems International; http://www.engica.com/engica-main-

6. Permit-to-work systems…electronic or paper? http://www.safetyapplication.com/

7. Sentinel PRO® Integrated Safe System of Work