Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 14 (2011) 1920–1928

Procedia Engineering

www.elsevier.com/locate/procedia

The Twelfth East Asia-Pacific Conference on Structural Engineering and Construction

The Application of Concurrent Engineering in the Installation of Foam Fire Extinguishing Piping System

T. P. Tsai[1a], H. C. Yang[2b], and P. H. Liao[2]

[1]*Institute of Technology Management, Chung Hua University, Taiwan*
[2]*Department of Construction Management, Chung Hua University, Taiwan*

Abstract

Although the concept of concurrent engineering has been widely applied in the manufacturing industry, there is growing awareness and interest in the adoption of Concurrent Engineering (CE) in the Construction Industry because CE has the potential to make construction projects less fragmented, reduce project duration, improve project quality, reduce total project cost and increase project competitiveness. The integration of a variety of complicated and even some trivial construction processes is the key issue to improve the efficiency in the construction industry. The concurrent engineering plays a key role in the integration of the construction process. The construction of the traditional fire extinguishing piping system is generally fabricated and installed in the job site. This has the tendency to waste a lot of piping materials and in turn increases construction cost, time and labor and will cut down construction quality.

This research, based on the concept of concurrent engineering through the use of the Delphi questionnaire analysis first establishes an evaluation framework for the piping installation. Issues and factors for each issue in the framework are determined. Then, for their practical applications, a seven determination management model (type determination, size determination, quantity determination, time determination, location determination, route determination, personnel and equipment determination) is proposed to consider these factors. Finally, the model is applied to verify three study cases. The obtained results indicate that 18% to 38% of the construction cost can be saved and 32% to 52% of the construction time reduced.

Keywords: Foam fire extinguishing piping, Concurrent Engineering, Delphi Method

[a] Presenter: Email: winnie.bears @msa.hinet.net
[b] Corresponding author: Email: hcyangse@chu.edu.tw

1877–7058 © 2011 Published by Elsevier Ltd. Open access under CC BY-NC-ND license.
doi:10.1016/j.proeng.2011.07.241

1. Introduction

Fire foam piping is used to fight mainly Class B fires in places such as factories or parking lots that have the risk of the ignition of organic solutions. However, the traditional fire piping construction is carried out on site in accordance with materials, time and resource estimates of the original design at the pre-construction stage. It has the tendency to generate too much material waste resulting in increased material costs, improper staff and equipment scheduling, wasting of time and manpower, increase of site safety and health costs, upgrades on site management hazardous environmental factors, even reduction of construction quality.

There is growing awareness and interest in the adoption of Concurrent Engineering (CE) in the Construction Industry because CE has the potential to make construction projects less fragmented, reduce project duration, improve project quality, reduce total project cost and increase project competitiveness. CE in construction can be applied from the conceptual state to the final construction stage. This paper addresses the challenge of improving the construction problems encountered for the foam fire piping installation within a concurrent engineering environment.

2. Literature Review

2.1. Concurrent engineering

Concurrent Engineering, sometimes called Simultaneous Engineering or Integrated Product Development (IPD), was defined by the Institute for Defense Analysis (IDA) as a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support. This approach is intended to cause the developers, from the outset, to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule, and user requirements (Winner et al. 1988).

In the context of the construction industry, Evbuomwan & Anumba define Concurrent Engineering as an attempt to optimize the design of the project and its construction process to achieve reduced lead times, and improved quality and cost by the integration of design, fabrication, construction, and erection activities and also by maximizing concurrency and collaboration in working practices (Evbuomwan and Anumba 1998). This is in sharp contrast with the traditional approach.

2.2. Foam fire extinguishing piping system

The piping system is usually designed by the mechanical engineer based on the architectural and structural drawings. From the completed piping system drawings, the contractor can do scheduling and estimate cost, materials, labor and equipment for the system first and then install it.

Foam systems include a foam concentrate, concentrate storage tank and piping, water supply piping and specialties, concentrate proportioning and mixing device, foam-water distribution piping, discharge devices, and controls. A fire pump may be required (AIA 2002).

3. Purpose and Research Method

The purpose of this research is to improve the construction problems encountered in the traditional foam fire extinguishing piping installation. An evaluation framework to be considered using concurrent engineering concept in the installation was established first using the Delphi Method.