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Achieving dry cut-and-cover stations – A membrane based waterproofing system for underground structures

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1 INTRODUCTION

Based on its success in achieving dry stations and tunnels in mined construction flexible waterproofing membranes are now being utilized for remedial waterproofing of old, leaking tunnels and for the waterproofing of cut-and-cover stations.

In the early 80's the Washington Metropolitan Transit Authority (WMATA) approved a value engineering change proposal for the construction of their Section B10, Wheaton Station. The VECP relied on the use of the NATM (New Austrian Tunneling Method) and by the economic approach of the concept promised cost savings. The selling point finally, however, was the proposed waterproofing system that relied on the use of flexible, plastic membranes. Now more than ten years after construction the Wheaton Station, and running tunnels remain completely dry, creating a comfortable space for Metro's patrons and an untroubled environment for the operations and maintenance staff. Since its success in Washington this waterproofing system has been adopted for many highway tunnels and subway structures.

With the extension of Metro's Redline to the north and completion of its Mid-City E-Route WMATA is again pioneering the field of waterproofing in the US by applying flexible, plastic membranes for the waterproofing of cut-and-cover structures. The Glenmont, Georgia Avenue-Petworth and Columbia Heights stations will utilize this same concept. While the Glenmont station uses the 'open system' with side wall drains, the Mid-City E-Route will rely on the 'closed system' by wrapping the entire structure into the membrane.

The same system is also being utilized for the remedial waterproofing of existing metro and highway tunnels and has recently been successfully applied at the Lehigh Tunnel No.1 in Pennsylvania.

2 WATERPROOFING SYSTEM

When designing a waterproofing system, be it for a new structure or remedial reasons it has to be acknowledged that the structure and its surrounding ground constantly undergo a change over time. A global tide, stress redistributions, temperature and moisture changes, sedimentation, erosion and other factors continuously change the path of water in the geologic host formation surrounding the underground structure. The structure itself exhibits changes in temperature, moisture and internal and external time dependent loadings which cause joints to open and close, creating new cracks, clogging up old ones, etc.

Knowledge of these facts led to the current worldwide acceptance of membrane type waterproofing systems because membranes bridge all of the above-mentioned openings, dislocations and other strain related movements (Sauer, et. al., 1987). When adopting a membrane based waterproofing system the following minimum requirements must be met:

- The waterproofing system must be continuous.
- The membrane must be able to adapt to irregularities of surfaces it is attached to.
- The membrane must remain permanently impervious despite rheological or structurally caused movements (long term behavior of ground, temperature variation, vibration, or shrinking and creeping of concrete).
- The waterproofing system must be able to bridge small cracks in the construction surface. It must be able to absorb discontinuous stress-variations and to a