Flow Regimes and Thermal Patterns in 15th Century BC Tombs of the Valley of Kings

Essam E. Khalil, Fellow ASME, Fellow ASHRAE, Fellow AIAA,
Professor of Mechanical Engineering, Cairo University, Cairo, Egypt

[ABSTRACT]

The cultural heritage left by the Egyptian Pharaohs in the tombs of the Valley of the Kings represents some of the key elements of the Egyptian cultural and tourism wealth and standing monuments demonstrating the wealth and technology of the pharaohs. These tombs were prepared to bury the Kings’ mummies and artifacts for eternal life. Many of the wall paintings identifying the various ancient rituals and life style are in good conditions as the tombs were only recently opened to the public and resulted, in many instances, to dramatic deterioration of the wall paintings due in part to excessive humidity. Basically, ventilation air design systems are considered here for the tomb passage of King Ramses VII, Ramses IV, Siti II and Bay including different visitors (obstacles) alternative positioning to adequately predict the actual air flow, thermal and moisture patterns in the tombs and hence to provide energy efficient design of ventilation system and reduce the adverse effect of excessive humidity.

Fig. 1: Tomb of Ramses VII , KV1

Fig. 2: Effect of moisture content in the colour of artifacts
The present work made use of packaged Computational Fluid Dynamics (CFD) programs. For the present work, following similar work of Abdel Aziz et al [1] and Khalil [2], a numerical study is carried out to define the optimum airside design of the tombs air ventilation and conditioning systems, which provides the optimum comfort and healthy conditions with optimum energy utilization. Basically, airside design types are considered here for the tomb passage of King Ramses VII, Ramses IV, Siti II and Bay, including different visitors (obstacles) alternative positioning to introduce the capability of the design to provide the optimum characteristics. The primary objective of the present work is to assess the airflow characteristics, thermal pattern and moisture distribution in the different tombs ventilation configurations in view of basic known flow characteristics. Tombs consist, typically of three gently sloping corridors. The free air supply and mechanically extracted ducted air play an important role in shaping the main flow pattern where the internal obstacles can distort the airflow pattern by increasing the recirculation zones or by deflecting the main airflow pattern, [3 and 4].