Wind-Driven Rain Studies. A C-FD-E Approach

**Summary**

Wind-driven rain studies provide the main input to problems such as:  
- post-ignition protection,  
- sealing, drainage accumulation.  
A Computational Fluid Dynamics (CFD) methodology is developed and used to compute  
- trajectories and local intensity factors for generic buildings,  
previously tested in the wind tunnel. The methodology is further applied to investigating real problems such as the role played by cornices in protecting the upper part of a low-rise building or the wetting and downwash on a sloped face of a high-rise building.

**METHODOLOGY, Models:**

- **Wind flow around buildings:** Navier-Stokes, continuity, turbulence models
- **Raindrops, size distribution:** mass fraction of droplets larger than $d$, $M(d) = \exp\left(-\left(d/d_0\right)^n\right)$
  
  with $d = bR_{u0}$—mean diameter, $n$ spread parameter, and $R_{u0}$ the undisturbed rainfall intensity
- **Trajectories (Lagrangian):** $\Delta x = F_T (u - u_p) + g R_{p - \rho} = \frac{1}{\rho u_p^2} \frac{\Delta x}{\Delta t} 24$
  
  Stokes drag, $u_p$ and $u_p$ wind and particle velocities.
- **Impact:** Local Intensity Factor $LIF_j$—the rainfall intensity on each building zone, $R_i$, reported to undisturbed rainfall intensity $R_0$.

**EXPERIMENTAL versus NUMERICAL RESULTS**

**APPLICATION – Cornice Effect for Low-Rise Building:**

Cornice effect: $F_j = \text{ratio (for every zone) between the LIF's without and with cornices}$

$$F_j = \frac{\text{LIF}_j}{\text{LIF}_{j}} \quad \text{without cornice}$$

If $F_j > 1$ cornice has positive effect

If $F_j < 1$ cornice has negative effect