30.4 Decay of Turbulence Downstream from a Stilling Basin

The turbulent pressure characteristics are important in designing for the cavitation resistance. With $p'$ as the fluctuating pressure component and $p_f$ as root-mean-square value (rms), the dimensionless pressure value $P = p_f / \left( \rho v_r^2 / 2 \right)$ varies only with dimensionless location $X = x / L_r$. The maximum $p_m'$ of the function $P(X)$ varies also with $F_1$ and is 0.08 for $F_1 = 4.5$, and smaller for other $F_1$. The distribution of pressure $P(X)$ along the jump can be expressed as $P / P_m = \left[ 3X e^{(1-3X)} \right]^2$.

For a given value $F_1$ of and thus $p_m$, the turbulent pressure has a maximum at $X = 1/3$, i.e. just behind the toe of the jump.

Leutheusser and his co-workers obtained the turbulence intensity and Reynolds stress using hot film anemometer in hydraulic jump. They concluded that the internal characteristics are influenced by whether the boundary layer is developed or otherwise. The position of the maximum velocity for developed case shifted upward near the commencement of the jump resulting in a surface wave. The tendency of flow separation on the beds and walls of the stilling basin is affected by inflow boundary development ($5 < x / y_2 < 7$ for $F_1 = 4$ and $3 < x / y_2 < 7$ for developed and undeveloped flows respectively). The tendency of boundary layer separation increased with increasing $F_1$ in undeveloped flow. Rajarathnam (1965, 1967) and later Thandaveswara (1975) have studied the velocity distribution in hydraulic jump. Thandaveswara studied the air entrainment characteristics of normal (classical) hydraulic jump and pre-entrained jump. Rajarathnam treated the jump as a wall jet.

Higher the degree of disintegration better it is. This information is very useful in the design of erosion protection. Lipay and Pustovoit in 1967 provided an equation for the $u_A^*$ maximum instantaneous velocity near the bed.
\[ \frac{u^*_A}{V_2} = 1.2 + \frac{0.2 F_1}{1 + 0.07 (x / y_2)^2} \]

It may be noted that nearly 5 to 10 times of the sequent depth are required for sustained decay of the excess of turbulent velocity component in the outflow from a stilling basin.