# LOFTING THE VIADUCT WITH A MINIMUM OF EFFORT

*George Kelly*

The Chetwynd Viaduct lies astride the Cork-Bandon road, its gaunt, dilapidated structure dominating the adjacent countryside. Since its construction in 1849 it has presented a formidable challenge to bowl-players, namely, to loft a 28 oz. bowl over its forbidding height of 90 feet. It is claimed that a Mr Dan Hurley from Bandon accomplished this feat in 1900 and, likewise, a Mr Bill Bennet of Killeady, Ballinhassig, Co. Cork, in the 1930s. There are, however, no written records to support these claims.

The first official attempt was in 1955 when a crowd of over 6,000 spectators gathered to witness eleven competitors endeavouring to "loft the viaduct". Amongst them were the famous Barry brothers from Cork, Mick and Ned, the former being regarded as the greatest bowler of all time. Both brothers succeeded in hitting the upper part of the framework with a 28 oz. bowl, but failed to get it over.

In August 1985 interest was again renewed in the event when a well-known Cork brewery offered £5,000 for what had by now come to be regarded as a superhuman sporting feat - the lofting of the viaduct with a 28 oz. bowl. Shortly after this, in fact on September 8th, 1985, history was made when before a crowd of almost 10,000 spectators a 23-year-old German Hans Bohlken, succeeded in doing exactly that. Bohlken used a ramp, which apparently is standard practice in German bowling and made himself £5,000 richer in the process.

The question of lofting the viaduct with a minimum amount of effort gives rise to an interesting problem in mechanics. It is well known that the path of a projectile moving under gravity only is a parabola whose equation can take the form



$$y = x\tan\alpha - \frac{gx^2}{2u^2\cos^2\alpha} \qquad (1)$$

Here x and y denote the horizontal and vertical directions respectively, and u at $\alpha$ with the horizontal is the initial velocity of projection. The two values of x for which the height is h are given by the quadratic

$$gx^2 - 2u^2\sin\alpha\cos\alpha + 2u^2h\cos^2\alpha = 0 \qquad (2)$$

and if 2d is the distance between these points, an easy calculation using Eqn (2) shows that

$$gd = u\cos\alpha(u^2\sin^2\alpha - 2gh)^{\frac{1}{2}} \qquad (3)$$

Eqn (3) defines u as a real function of $\alpha$ since the expression under the radical is always positive. The value of $\alpha$ which gives the least value of u may be obtained most easily by re-writing (3) in the form

$$u^4\cos^4\alpha - u^2(u^2 - 2gh)\cos^2\alpha + g^2d^2 = 0 \qquad (4)$$

and noting that Eqn (4) will have equal roots in $\cos^2\alpha$ if $u^2 = 2g(h\pm d)$. But this is precisely the condition that u be minimum and since $u^2 > 2gh$, this minimum value is given by

$$u^2 = 2g(h + d) \qquad (5)$$

The corresponding value of $\alpha$ is obtained from Eqn (4) in the form

$$\cos^2\alpha = \frac{d}{2(h + d)} \quad \text{or} \quad \sin^2\alpha = \frac{2h + d}{2(h + d)} \qquad (6)$$

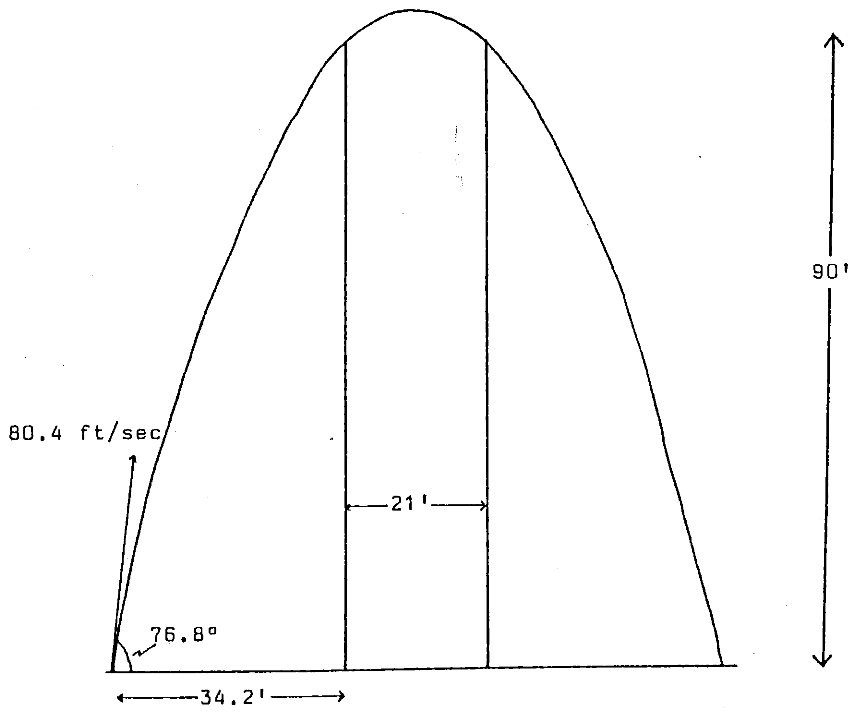
If $x_0$ and $x_0 + 2d$ are the two roots of Eqn (2), then using Eqn (6) and the familiar formula for the roots of a quadratic equation gives

$$x_0 + d = \frac{u^2}{g}\sin\alpha\cos\alpha = \sqrt{d(2h + d)} \qquad (7)$$

Equations (5), (6) and (7) are directly applicable to the viaduct problem upon taking $h = 90$ feet, $2d = 21$ feet and $g = 32.10$ ft/sec$^2$. The values obtained are

$$u = 80.4 \text{ ft/sec}, \quad \alpha = 76.79°, \quad x = 34.2 \text{ ft}, \qquad (8)$$

where $x_0$ is the distance from the viaduct at which the loft should be made (the value of 45 feet quoted in the *Cork Examiner*, 1977, is measured from the centre of the viaduct).




Regrettably, the use of a ramp by the German victor has given rise to some controversy. Since, however, the height of the ramp is small compared to the height of the viaduct, the overall results in (8) would be largely unchanged. A much more important factor is that running up the ramp generates vertical velocity which is automatically communicated to the bowl and makes it easier to attain the component $u \sin \alpha$ which is required by Eqn (8). On the other hand, there is no doubt that to loft from a ramp requires an extra degree of skill to use the ramp effectively. In fact, Bohlken has been described as having an "incredible technique".

It seems reasonably certain that further attempts will be made at lofting the viaduct.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