# Closure to "New Approach for the Computation of the Water Surface Angle in Partially Filled Pipes: Pipes Arranged in Parallel" by Lotfi Zeghadnia and Jean Loup Robert

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The writers appreciate the discusser's interest in their work and thank him for his comments and suggestions.

The writers intend to clarify many issues addressed in the discussion:

In the original paper, the authors presented a largely new approach for the computation of the water surface angle in pipes arranged in parallel using a known reference pipe's characteristics. The new method is elaborated to overcome the laborious trial-and-error method. Practically, four scenarios can be found for the computation of the water surface angle using the concept of a reference (Zeghadnia et al. 2014a).

## Response to the Discussion about the Definition of a Reference Pipe

For the first point, the discusser reported that "reference pipes need not be present in any network," which is not correct; the reference pipe as mentioned in Fig. 2 of the original paper is not fictitious, it is a part of the network, but in general it should be in the head of the net compared to the unknown pipes.

## Response to the Discussion Presented through Eqs. (1)–(6)

Eq. (1) of the discussion is correct where the formulas can be simplified to such form; we want to thank the discusser. However, Eqs. (4)–(6) of the discussion were developed using the assumption of $\theta_d = \theta_r$ and are not correct compared to the hypothesis in the original paper where

- The flow in the unknown pipe is likely different compared to the flow in the reference pipe as explained in the original paper, whatever the type of flow [in partially filled section or full section (Zeghadnia 2007)], which probably means $\theta_d \neq \theta_r$; and
- $Q_d = Q_r$ and probably $S_d = S_r$, $n_d = n_r$ meaning the pipes are the same, and the both diameters are equal: $D_d = D_r$.

On the other hand, one case where the assumption of $\theta_d = \theta_r$ can be considered correct is where the following equation is satisfied:

$$\left(\frac{S_d^{1/2}}{n_d}\right)^{3/8}\left(\frac{n_r}{S_r^{1/2}}\right)^{3/8} = \left(\frac{Q_d}{Q_r}\right)^{3/8}\left(\frac{D_r}{D_d}\right) \quad (1)$$

Assume that

$$S_d = S_r, \qquad n_d = n_r \quad (2)$$

The equation can be simplified to the following form:

$$(D_d)^{3/8} Q_r = (D_r)^{3/8} Q_d \quad (3)$$

Assume that

$$D_d = D_r \quad (4)$$

It is easy to deduce the following:

$$Q_d = Q_r \quad (5)$$

Eq. (5) is not an assumption of the proposed approach.

## Response to the Discussion about the Accuracy Test

The discusser mentioned that "the 'accuracy test' of the paper does not test any Case 7 problem to determine unknown central surface angles." The discusser has perhaps not read the paper published previously, Zeghadnia et al. (2014a, b), where the computation of the velocity was studied. However the accuracy test of the proposed equations in the original paper was studied correctly.

The example proposed by the discusser does not respect the hypothesis of the known reference pipe method (KRPM) and always imposes that $\theta_d = \theta_r$, which is not correct as reported previously.

The discusser used the following hypothesis:

$D_d = D_r$ and $D_d$ is full, so the following equation can be written:

$$\frac{Q_r}{Q_{\text{full}}} = \frac{(\theta - \sin\theta)^{5/3}}{2\pi\theta^{2/3}} = 1 \quad (6)$$

The numerical solution of Eq. (6) gives a wrong result compared to the KRPM and shows a big difference. This point of view completely lack accuracy because of the following.



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Assume that $D_d = D_r$ is correct and $D_d$ is full; the Manning equation can be expressed as follows:

$$D_d = \left(\frac{Q_d n_d 4^{(5/3)}}{\pi S_d^{1/2}}\right)^{3/8} \quad (7)$$

Using Eq. (6) of the discussion, it is easy to deduce the following formula, where $n_d = n_r$ and $S_d = S_r$:

$$\theta_d = \left(\frac{Q_d}{Q_r}\right)^{3/8}\left(\frac{D_r}{D_d}\right)\theta_r \quad (8)$$

For a full pipe, the surface water angle $\theta_d = 2\pi$.

The combination of Eqs. (7) and (8) gives the following:

$$2\pi = \left(\frac{Q_d}{Q_r}\right)^{3/8}\left(\frac{D_r}{\left(\left(\frac{Q_d n_d 4^{(5/3)}}{\pi S_d^{1/2}}\right)^{3/8}\right)}\right)\theta_r \quad (9)$$

From Eq. (9), the diameter $D_r$ can be expressed as follows:

$$D_r = \left(\frac{2\pi}{\theta_r}\right)\left(\frac{Q_r n_d 4^{(5/3)}}{\pi S_d^{1/2}}\right)^{3/8} \quad (10)$$

Based on the assumption that $D_r = D_d$ the water surface angle takes the following value:

$$\theta_r = 2\pi$$

This is entirely different than the discusser's hypothesis.

It is clear that the error computed by the discusser has no reason because the both Eq. (10) and Eq. (3) of the discussion explained the same logic.

We thank the discusser for the contribution; we also hope that KRPM has become clearer than before.

## References

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