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Exact Nature Of K-K Model Coupled With G-M Equation On The Rate Of Flow Of Waste Water Used For Sewer Design

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Abstract- In this paper, a pioneering method endowed on the rate of the flow of surplus water used for sewer design. Here the innovative arduous solutions scrutinized on seventh order K-K model coupled with G-M equation. These solutions have innumerable insistences in the field of physics and other zones. Embraced consequences will succour as a very imperious breakthrough in the awareness of the rate of the flow of surplus water used for sewer design. We also have exposed the method which is an operative implement for seventh order K-K model.

Keywords – Kaup-Kuperschmidt, Sewer design, Sewer dynamics, Gauckler–Manning's equation, seventh order equation

I. INTRODUCTION

In this paper, a novel technique endowed on the rate of the flow of waste water used for sewer design. Here the inventive laborious solutions dissected on seventh order K-K model coupled [1] with G-M equation [2]. These solutions have uncountable insistences in the field of physics and other tracts. Embraced consequences will succour as a very imperious breakthrough in the awareness of the rate of the flow of surplus water used for sewer design. We also have exposed that the widespread method [3] is an operative implement for seventh order K-K model.

Many reckoning skills [4-6] convey out a necessary earmark in immeasurable yields in Fluid-Mechanics, Hydro-dynamics, and so on. Newly ground-breaking skills executed for offering these projections. The perseverance of this manhandle is to validate the propensity of the new method for getting precise nature of the rate of the flow of waste water used for sewer design.

II. MODEL AND DYNAMICS

In this paper, illustrating the rate of the flow of waste water used for sewer design using seventh order K-K model:

$$\left(\frac{d\Phi}{dt}+\frac{d^7\Phi}{dx^7}+15\Phi\,\frac{d^5\Phi}{dx^5}+\frac{145}{2}\Phi_x\,\frac{d^4\Phi}{dx^4}+45\Phi^2\,\frac{d^3\Phi}{dx^3}+\frac{255}{2}\frac{d^2\Phi}{dx^2}\frac{d^3\Phi}{dx^3}+270\Phi\,\Phi_x\Phi_{xx}+\ 90\Phi_x^3\right)=0 \tag{2.1a}$$

Coupling en. (2.1a) with G-M equation on the rate of the flow of waste water used for sewer design

$$\frac{d\Phi}{dt} = \left(\frac{1}{n}\right) k_a D^2 (k_r D)^{2/3} i^{1/2}$$

(2.1b)

Here $\frac{d\Phi}{dt}$ is the value of waste water flow used for sewer design, $k_a = \frac{\pi}{4}$, $k_r = 0.25$, n = 0.013 (G-K roughness coefficient), D is diameter of sewage line $(D_{min.} = 100\ mm)$ and i is sewer gradient usually = 0.004694 for peak cities, yielding the $\frac{d\Phi}{dt} = 0.0035153\ m^3/s$.

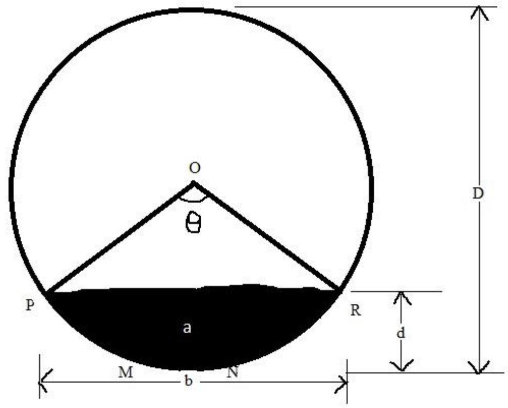

Fig. 2.1 - CIRCULAR SEWER DESIGN
(a – area of flow, b – breadth of flow, d - depth of flow, θ - depth of flow, D – sewer diameter, PMNR – wetted perimeter, OP – hydraulic radius)

Coupling eqns. (2.1a) and (2.1b) and solving (2.1), using the travelling wave transformation [7-9]: $\Phi(\zeta) = \Phi(x,t)$

Let $\zeta = (x - t)$

(2.2)

Therefore, simplified coupled ODE:

$$\left(-\Phi' + \Phi''''''' + 15\Phi\Phi' + \frac{145}{2}\Phi'\Phi'''' + 45\Phi^2\Phi''' + \frac{255}{2}\Phi''\Phi''' + 270\Phi\Phi'\Phi'' + 90\Phi'^3\right) = 0$$

(2.3)

Integrating 3 times

$$\Phi'''' + \frac{89\Phi^3}{6} + \frac{45}{4}\Phi'^2 - 15\Phi\Phi'' = 0$$

(2.4)

Bearing in mind the equilibrium between the ultimate order derivatives and non-linear interactions,

$$(N - m)\ p_0 = S_0(N - m + Q_0)$$

(2.5)

Here, $p_0 = 3, S_0 = 1, Q_0 = 4$, hence

$$N = m + 2$$

(2.6)

Setting m =1 and defining Φ as

$$\Phi(\zeta) = \frac{\alpha_0 + \alpha_1\Omega + \alpha_2\Omega^2 + \alpha_3\Omega^3}{\beta_0 + \beta_1\Omega}$$

(2.7a)

$$\Omega' = \Omega^2 - \Omega$$

(2.7b)

$$\Omega = \frac{1}{1 + \zeta_0 \exp(\zeta)}$$

(2.7c)

Illustrating $\Phi', \Phi'', \Phi''' \text{ and } \Phi''''$ from en. (2.7), sustaining in en. (2.4) and equating the coefficients of Ω, Ω^2, Ω^3 etc., and finding the values of $\alpha_0, \alpha_1, \alpha_2, \alpha_3, \beta_0 \text{ and } \beta_1$,

Solution set 1: $\alpha_0 = -1, \alpha_1 = 1,$
$\beta_0 = \alpha_2 = \alpha_3 = 0 \text{ and } \beta_1 = 0.306$

$$\Phi(x,t) = \frac{-1+\left(\frac{1}{1+\zeta_0 \exp(x-t)}\right)}{0.306\left(\frac{1}{1+\zeta_0 \exp(x-t)}\right)} \tag{2.8}$$

Solution set 2: $\alpha_0 = -1, \alpha_1 = 1,$
$\beta_0 = \alpha_2 = \alpha_3 = 0 \text{ and } \beta_1 = -3.272$

$$\Phi(x,t) = \frac{-1+\left(\frac{1}{1+\zeta_0 \exp(x-t)}\right)}{-3.272\left(\frac{1}{1+\zeta_0 \exp(x-t)}\right)} \tag{2.9}$$

Solution set 3: $\alpha_0 = 0, \alpha_1 = 0, \beta_0 = -0.6, \alpha_2 = 0.0452, \alpha_3 = 0 \text{ and } \beta_1 = 0$

$$\Phi(x,t) = 0.0753\left(\frac{1}{1+\zeta_0 \exp(x-t)}\right)^2 \tag{2.10}$$

Similarly further solution arrays can be augmented.

III. CONCLUSION

A ground-breaking method has been applied on widespread illustrating the rate of the flow of waste water used for sewer design using seventh order K-K model. We inspected the innovative exact roving and solitary wave resolutions of K-K model. We also have exposed that the configuration of the families of solutions (en. 2.8 to en. 2.10) and the product $\boldsymbol{\Phi(x,t)\Phi(y,t)\Phi(z,t)}$ is matching with investigational value of volume of the flow of waste water used for sewer design i.e. $\mathbf{0.0035153}t$ litre. Attained consequences will promote very commanding momentous in the knowledge of flow of heavier fluids.

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