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Specific Energy and Critical Depth Formulas

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List of 23 Specific Energy and Critical Depth Formulas

Specific Energy and Critical Depth

1) Area of Section Considering Condition of Maximum Discharge

$$\text{fx } A_{cs} = \left(Q \cdot Q \cdot \frac{T}{[g]} \right)^{\frac{1}{3}}$$

Open Calculator 

$$\text{ex } 3.475241\text{m}^2 = \left(14\text{m}^3/\text{s} \cdot 14\text{m}^3/\text{s} \cdot \frac{2.1\text{m}}{[g]} \right)^{\frac{1}{3}}$$

2) Area of Section given Discharge

$$\text{fx } A_{cs} = \frac{Q}{\sqrt{2 \cdot [g] \cdot (E_{\text{total}} - d_f)}}$$

Open Calculator 

$$\text{ex } 1.37314\text{m}^2 = \frac{14\text{m}^3/\text{s}}{\sqrt{2 \cdot [g] \cdot (8.6\text{J} - 3.3\text{m})}}$$



3) Area of Section of Open Channel Considering Condition of Minimum Specific Energy

$$fx \quad A_{cs} = \left(Q \cdot \frac{T}{[g]} \right)^{\frac{1}{3}}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$ex \quad 1.441923m^2 = \left(14m^3/s \cdot \frac{2.1m}{[g]} \right)^{\frac{1}{3}}$$

4) Datum Height for Total Energy per unit Weight of Water in Flow Section

$$fx \quad y = E_{total} - \left(\left(\frac{V_{mean}^2}{2 \cdot [g]} \right) + d_f \right)$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$ex \quad 98.93746mm = 8.6J - \left(\left(\frac{(10.1m/s)^2}{2 \cdot [g]} \right) + 3.3m \right)$$

5) Depth of Flow given Discharge

$$fx \quad d_f = E_{total} - \left(\frac{\left(\frac{Q}{A_{cs}} \right)^2}{2 \cdot [g]} \right)$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$ex \quad 7.735535m = 8.6J - \left(\frac{\left(\frac{14m^3/s}{3.4m^2} \right)^2}{2 \cdot [g]} \right)$$



6) Depth of Flow given Total Energy in Flow Section taking Bed Slope as Datum

$$\text{fx } d_f = E_{\text{total}} - \left(\left(\frac{V_{\text{mean}}^2}{2 \cdot [g]} \right) \right)$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$\text{ex } 3.398937\text{m} = 8.6\text{J} - \left(\left(\frac{(10.1\text{m/s})^2}{2 \cdot [g]} \right) \right)$$

7) Depth of Flow given Total Energy per Unit Weight of Water in Flow Section

$$\text{fx } d_f = E_{\text{total}} - \left(\left(\frac{V_{\text{mean}}^2}{2 \cdot [g]} \right) + y \right)$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$\text{ex } 3.358937\text{m} = 8.6\text{J} - \left(\left(\frac{(10.1\text{m/s})^2}{2 \cdot [g]} \right) + 40\text{mm} \right)$$

8) Diameter of Section given Froude Number

$$\text{fx } d_{\text{section}} = \frac{\left(\frac{V_{\text{FN}}}{\text{Fr}} \right)^2}{[g]}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$\text{ex } 4.996609\text{m} = \frac{\left(\frac{70\text{m/s}}{10} \right)^2}{[g]}$$



9) Diameter of Section through Section Considering Condition of Minimum Specific Energy

$$\text{fx } d_{\text{section}} = \frac{V_{\text{mean}}^2}{[g]}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$\text{ex } 10.40213\text{m} = \frac{(10.1\text{m/s})^2}{[g]}$$

10) Discharge through Area

$$\text{fx } Q = \sqrt{2 \cdot [g] \cdot A_{\text{cs}}^2 \cdot (E_{\text{total}} - d_f)}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$\text{ex } 34.66508\text{m}^3/\text{s} = \sqrt{2 \cdot [g] \cdot (3.4\text{m}^2)^2 \cdot (8.6\text{J} - 3.3\text{m})}$$

11) Discharge through Section Considering Condition of Maximum Discharge

$$\text{fx } Q = \sqrt{(A_{\text{cs}}^3) \cdot \frac{[g]}{T}}$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$\text{ex } 13.54781\text{m}^3/\text{s} = \sqrt{((3.4\text{m}^2)^3) \cdot \frac{[g]}{2.1\text{m}}}$$



12) Discharge through Section Considering Condition of Minimum Specific Energy

$$\text{fx } Q = \sqrt{(A_{cs}^3) \cdot \frac{[g]}{T}}$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

$$\text{ex } 13.54781\text{m}^3/\text{s} = \sqrt{\left((3.4\text{m}^2)^3\right) \cdot \frac{[g]}{2.1\text{m}}}$$

13) Froude Number given Velocity

$$\text{fx } Fr = \frac{V_{FN}}{\sqrt{[g] \cdot d_{\text{section}}}}$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)

$$\text{ex } 9.996609 = \frac{70\text{m/s}}{\sqrt{[g] \cdot 5\text{m}}}$$

14) Mean Velocity of Flow for Total Energy per Unit Weight of Water in Flow Section

$$\text{fx } V_{\text{mean}} = \sqrt{(E_{\text{total}} - (d_f + y)) \cdot 2 \cdot [g]}$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60_img.jpg\)](#)

$$\text{ex } 10.15706\text{m/s} = \sqrt{(8.6\text{J} - (3.3\text{m} + 40\text{mm})) \cdot 2 \cdot [g]}$$



15) Mean Velocity of Flow given Froude Number

[Open Calculator !\[\]\(feabb98897b440bc8695a03336a6e2df_img.jpg\)](#)

$$\text{fx } V_{\text{FN}} = \text{Fr} \cdot \sqrt{d_{\text{section}} \cdot [g]}$$

$$\text{ex } 70.02375\text{m/s} = 10 \cdot \sqrt{5\text{m} \cdot [g]}$$

16) Mean Velocity of flow given Total Energy in flow section taking Bed Slope as Datum

[Open Calculator !\[\]\(642aa997563f9a325b310230bb5078b7_img.jpg\)](#)

$$\text{fx } V_{\text{mean}} = \sqrt{(E_{\text{total}} - (d_f)) \cdot 2 \cdot [g]}$$

$$\text{ex } 10.19561\text{m/s} = \sqrt{(8.6\text{J} - (3.3\text{m})) \cdot 2 \cdot [g]}$$

17) Mean Velocity of Flow through Section Considering Condition of Minimum Specific Energy

[Open Calculator !\[\]\(51514032c8ca341817228f39f1307b05_img.jpg\)](#)

$$\text{fx } V_{\text{mean}} = \sqrt{[g] \cdot d_{\text{section}}}$$

$$\text{ex } 7.002375\text{m/s} = \sqrt{[g] \cdot 5\text{m}}$$



18) Top Width of Section Considering Condition of Maximum Discharge

Open Calculator 

$$\text{fx } T = \sqrt{(A_{cs}^3) \cdot \frac{[g]}{Q}}$$

$$\text{ex } 5.247044\text{m} = \sqrt{((3.4\text{m}^2)^3) \cdot \frac{[g]}{14\text{m}^3/\text{s}}}$$

19) Top Width of Section through Section Considering Condition of Minimum Specific Energy

Open Calculator 

$$\text{fx } T = \left((A_{cs}^3) \cdot \frac{[g]}{Q} \right)$$

$$\text{ex } 27.53147\text{m} = \left(((3.4\text{m}^2)^3) \cdot \frac{[g]}{14\text{m}^3/\text{s}} \right)$$

20) Total Energy per unit Weight of Water in Flow Section

Open Calculator 

$$\text{fx } E_{\text{total}} = \left(\frac{V_{\text{mean}}^2}{2 \cdot [g]} \right) + d_f + y$$

$$\text{ex } 8.541063\text{J} = \left(\frac{(10.1\text{m/s})^2}{2 \cdot [g]} \right) + 3.3\text{m} + 40\text{mm}$$



21) Total Energy per unit Weight of Water in Flow Section considering Bed Slope as Datum

$$\text{fx } E_{\text{total}} = \left(\frac{V_{\text{FN}}^2}{2 \cdot [g]} \right) + d_f$$

[Open Calculator !\[\]\(c3d993ca47bfe2a953c700506ce31fa0_img.jpg\)](#)

$$\text{ex } 253.1305\text{J} = \left(\frac{(70\text{m/s})^2}{2 \cdot [g]} \right) + 3.3\text{m}$$

22) Total Energy per unit Weight of Water in Flow Section given Discharge

$$\text{fx } E_{\text{total}} = d_f + \left(\frac{\left(\frac{Q}{A_{\text{cs}}} \right)^2}{2 \cdot [g]} \right)$$

[Open Calculator !\[\]\(17413706fd4997a1a4bdf85c6864eee1_img.jpg\)](#)

$$\text{ex } 4.164465\text{J} = 3.3\text{m} + \left(\frac{\left(\frac{14\text{m}^3/\text{s}}{3.4\text{m}^2} \right)^2}{2 \cdot [g]} \right)$$

23) Volume of Liquid Considering Condition of Maximum Discharge

$$\text{fx } V_w = \sqrt{(A_{\text{cs}}^3) \cdot \frac{[g]}{T}} \cdot \Delta t$$

[Open Calculator !\[\]\(4b7a79268f6ba26c1471d4232fffa85a_img.jpg\)](#)

$$\text{ex } 16.93476\text{m}^3 = \sqrt{\left((3.4\text{m}^2)^3 \right) \cdot \frac{[g]}{2.1\text{m}}} \cdot 1.25\text{s}$$










Variables Used

- **A_{CS}** Cross-Sectional Area of Channel (Square Meter)
- **d_f** Depth of Flow (Meter)
- **$d_{section}$** Diameter of Section (Meter)
- **E_{total}** Total Energy (Joule)
- **Fr** Froude Number
- **Q** Discharge of Channel (Cubic Meter per Second)
- **T** Top Width (Meter)
- **V_{FN}** Mean Velocity for Froude Number (Meter per Second)
- **V_{mean}** Mean Velocity (Meter per Second)
- **V_w** Volume of Water (Cubic Meter)
- **y** Height above Datum (Millimeter)
- **Δt** Time Interval (Second)







Constants, Functions, Measurements used

- **Constant:** [g], 9.80665
Gravitational acceleration on Earth
- **Function:** sqrt, sqrt(Number)
A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- **Measurement: Length** in Meter (m), Millimeter (mm)
Length Unit Conversion 
- **Measurement: Time** in Second (s)
Time Unit Conversion 
- **Measurement: Volume** in Cubic Meter (m³)
Volume Unit Conversion 
- **Measurement: Area** in Square Meter (m²)
Area Unit Conversion 
- **Measurement: Speed** in Meter per Second (m/s)
Speed Unit Conversion 
- **Measurement: Energy** in Joule (J)
Energy Unit Conversion 
- **Measurement: Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
Volumetric Flow Rate Unit Conversion 



Check other formula lists

- [Computation of Uniform Flow Formulas](#) 
- [Critical Flow and its Computation Formulas](#) 
- [Geometrical Properties of Channel Section Formulas](#) 
- [Metering Flumes and Momentum in Open Channel Flow Specific Force Formulas](#) 
- [Specific Energy and Critical Depth Formulas](#) 

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