MATS-TC: Automating Time of Concentration Through Multidisciplinary Collaboration

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MATS-TC: Automating Time of Concentration Through Multidisciplinary Collaboration

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Overview

- Time of Concentration
- Previous process
- Full Automation
- Outcome
- Moving Toward the Future
Time of Concentration
Time of Concentration

- Time of concentration \((T_c)\) is the time required for runoff to travel from the hydraulically most distant point in the watershed to the outlet.
Velocity Method

- Adds the travel time of various flow types, the sum is the watershed’s TC
- Three main flow types
  - Sheet
  - Shallow Concentrated
  - Channel
- Each flow has its own formula for travel time
Travel Time Formulas

- **Sheet**

\[ T_t = \frac{0.007(n\ell)^{0.8}}{(P_2)^{0.5}S^{0.4}} \]  

(eq. 15–8)

where:

- \( T_t \) = travel time, h
- \( n \) = Manning's roughness coefficient (table 15–1)
- \( \ell \) = sheet flow length, ft
- \( P_2 \) = 2-year, 24-hour rainfall, in
- \( S \) = slope of land surface, ft/ft

- **Shallow Concentration**

- **Channel**

\[ V = \frac{1.49r^{\frac{2}{3}}s^{\frac{1}{3}}}{n} \]  

(eq. 15–10)

where:

- \( V \) = average velocity, ft/s
- \( r \) = hydraulic radius, ft
- \( a = \frac{a}{P_w} \) = cross-sectional flow area, ft²
- \( P_w \) = wetted perimeter, ft
- \( s \) = slope of the hydraulic grade line (channel slope), ft/ft
- \( n \) = Manning's \( n \) value for open channel flow

Travel time \((T_t)\) is the ratio of flow length to flow velocity:

\[ T_t = \frac{L}{3600V} \]  

(eq. 3-1)

where:

- \( T_t \) = travel time (hr)
- \( L \) = flow length (ft)
- \( V \) = average velocity (ft/s)
- 3600 = conversion factor from seconds to hours.
"I had my doctor do a DNA blood analysis. As I suspected, I'm missing the math gene."
Previous Process
Manual Process

- Inputs created manually
  - Stream widths & depths
  - Stream segment splitting
  - Stream segment attribution

- Data Calculations
  - Data exported, processed, imported back
  - Formula components added manually
  - Large file size
The Beginning

- Simple question
  - Split line segments 0 – 100 feet | 100 feet – end

- Questions of increasing complexity
  - Add slope to each segment

- Time of concentration calculations

- Key indicators
  - Repetitive; Multiple steps/outputs; Multiple data formats
Full Automation
Jumping Off Point

- Automating engineering decisions
  - Feasibility
  - Time
  - Level of effort
  - Accuracy
  - Quality
MATS Process

- Multi-disciplinary Automated Technical Solution
  - Collaborative approach
  - Finding commonalities
  - What’s needed/what’s possible/what’s available
  - Identify critical elements
MATS-TC

- Process/Format Data
- Create TC Inputs
- Calculate Time of Concentration
- QA/QC
Outcome
Results and Benefits

TC
- Accuracy
- Speed
- Repeatability
- Data Integrity
- Project Time
- Manual Processing
- Subjective Decision Making
- Human Error

MATS
- Collaboration
- Communication
- Innovation
- Interdisciplinary Understanding
Moving Toward the Future
Next Steps

- **TC**
  - Refine as more areas are studied
  - Improve error handling and documentation
  - Test and update for a variety of different areas and situations

- **MATS**
  - Make collaboration contagious
  - Increase interdisciplinary understanding
  - Apply method to other workflows
  - Mats
    - TC
    - ???
Thank you!

- Questions? Please email us:
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