# Memo – WHTS/RIC Excavation Sequence

- RIC model: Assign chainage and excavation sequence directly to nodes, skip elements (start from Step 4).

- Python Folder: O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\WHT\python

|  |  |  |
| --- | --- | --- |
|  | Python Scripts | Description |
| Task 1 | Step 1: MeshIO\_flac\_to\_feflow.py | Convert mesh from FLAC3D (.f3grid) to a FEFLOW model (.vtu), via Python meshIO. |
| Step 2: \*Manual export  Export element centroids and node coordinates from FEFLOW. | FEFLOW node numbers are rearranged, element number unchanged. |
| Task 2 | Step 3: MapNodes\_feflow\_flac.py | Mapping FLAC and FEFLOW nodes by coordinates. |
| Task 3 | Step 4: AssignChainage.py | Assign chainages for excavated elements in each control line (RouteID). |
| Step 5: AssignExcavSequence.py | Assign excavation date to elements, according to Route ID and chainage. Add ExcelDate and POWID to element-date dataframe. |
| Step 6: nodal\_linking\_HT.py | Link construction sequence from elements to nodes |
| Step 7: write\_TimeSeries\_pow.py | Generate FEFLOW TimeSeries POW file. |

**WHT Excavation Sequence**

Inputs 🡪 Outputs

group

Grouped Elements

Centroid Coords

FEFLOW Nodes Coords

**Daily Road Header**

filter

FLAC Nodes

Excavated Elements

All Elements

merge

(Step5)

Excavation

* Chainage
* RouteID
* Date

Control Line

* RouteID
* Chainage Coords

**Control Line Files**

Excavated Elements

* Centroid Coords
* RouteID
* Chainage

Step3: MapNodes\_feflow\_flac.py

Step4: AssignChainage.py

Step1: MeshIO\_flac\_to\_feflow.py

Step2: FEFLOW node & element export

Step5: AssignExcavSequence.py

Step7: write\_TimeSeries\_pow.py

Step6: nodal\_linking\_HT.py

Cut&Cover Sequence

* Element Coords
* Node Coords
* Route ID
* Chainage
* Date
* Wkly Date
* PowDateNum
* POWID

Tunnel Sequence

* Element Coords
* Node Coords
* Route ID
* Chainage
* Date
* Wkly Date
* PowDateNum
* POWID

(Step 7)

POW function file

* POWID

Feflow Node

* Coords
* Route ID
* Chainage
* Date
* Wkly Date
* PowDateNum

(Step6)

Excav Element

* Coords
* Route ID
* Chainage
* Date
* Wkly Date
* PowDateNum

(Step4)

(Step2)

map

(Step3)

**FLAC3D Mesh**

(Step1)

**Converted FEFLOW File**

**RIC Excavation Sequence (Adapt from WHT)**

Inputs 🡪 Outputs

RIC Nodes

* Coords

**FEFLOW HHBC.shp**

WHT geometry

* RouteIDs

**FLAC3D & Rhino**

map & group

Control Line

* Chainage Coords

**Control Line Files**

Excavation

* Chainage
* RouteID
* Date

**Daily Road Header**

Tunnel Sequence

* Node Coords
* Route ID
* Chainage
* Date
* Wkly Date
* PowDateNum
* POWID

POW function file

* POWID

Cut&Cover Sequence

(manually edit in Manifold)

* Node Coords
* Route ID
* Chainage
* Date
* Wkly Date
* PowDateNum
* POWID

Excavated Nodes

* Coords
* RouteID
* Chainage

**Inputs / Outputs**

\* Links are not updated

**Task 1 Convert FLAC3D (.f3grid) to FEFLOW (.vtu)**

Python: MeshIO\_flac\_to\_feflow.py

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  | Note |
| Input files | 1) mesh2. f3grid | [\\anf.psm.local\anf-files02\3000\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\Mesh2.f3grid](file:///\\anf.psm.local\anf-files02\3000\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\Mesh2.f3grid) |  |
| Output files | 2) mesh2.vtu | [\\anf.psm.local\anf-files02\3000\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\Mesh2.vtu](file:///\\anf.psm.local\anf-files02\3000\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\Mesh2.vtu) | \*Node IDs are renumbered |
|  | 3) FEFLOW\_Element\_ centroids.dat | [\\anf.psm.local\anf-files02\3000\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\Feflow\_Element\_centroids.dat](file:///\\anf.psm.local\anf-files02\3000\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\Feflow_Element_centroids.dat) | \* Manually export from FEFLOW 7.2  \* As input in Task 2 |
|  | 4) FEFLOW\_Nodes \_Coordinates.dat | [\\anf.psm.local\anf-files02\3000\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\Feflow\_Nodes\_Coords.dat](file:///\\anf.psm.local\anf-files02\3000\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\Feflow_Nodes_Coords.dat) | \* Manually export from FEFLOW  \* As input in Task 2 |

**Task 2 Map Flac and Feflow Node number, Build FEFLOW Element–Node Connectivity**

Python: MapNodes\_feflow\_flac.py

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  | Note |
| Input files | 3) FEFLOW\_Element \_centroids | [\\anf.psm.local\anf-files02\3000\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\Feflow\_Element\_centroids.dat](file:///\\anf.psm.local\anf-files02\3000\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\Feflow_Element_centroids.dat) |  |
|  | 4) FEFLOW\_Nodes \_Coordinates | [\\anf.psm.local\anf-files02\3000\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\Feflow\_Nodes\_Coords.dat](file:///\\anf.psm.local\anf-files02\3000\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\Feflow_Nodes_Coords.dat) |  |
| Output files | 5) all\_data\_v2.csv | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\all\_data\_v2.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\all_data_v2.csv) | \*Element properties |
|  | 6) tunnel\_excavated.csv | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\tunnel\_excavated.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\tunnel_excavated.csv) | \* Filtered, keep excavated elements only |
|  | 13) mapped\_nodes.csv | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\mapped\_nodes.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\mapped_nodes.csv) | \*Mapping FLAC3D and FEFLOW Node coordinates and numbers |
|  |  |  |  |

**Task 3 (Step 4) Assign Chainage for Excavated Elements**

Python: AssignChainage.py

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  | Note |
| Input files | 6) tunnel\_excavated.csv | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\WHT\tunnel\_excavated.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\WHT\tunnel_excavated.csv) |  |
|  | 7) control line.csv | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\WHT\Control line.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\WHT\Control%20line.csv) | \*Start and End chainage for each control line |
|  | 8) Control Line  <folder> | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\WHT\ControlLine](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\WHT\ControlLine) | \*Control Line coordinates (one .csv per Route) |
| Output files | 9) Chainage-Calculate <folder> | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\WHT\Chainage-Calculate](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\WHT\Chainage-Calculate) | \*Group excavated elements by chainage (one .csv per route) |

**Task 3 (Step 5) Assign Construction Sequence to Element according to chainage group**

Python: AssignExcavSequence.py

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  | Note |
| Input files | 10) sequence.csv | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\sequence.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\sequence.csv) | \*Construction sequence extracted from DailyRoadHeader attribute table |
|  | 9) Chainage-Calculate <folder> | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\WHT\Chainage-Calculate](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\WHT\Chainage-Calculate) |  |
| Output files | 11) Chainage-Sequence  <folder> | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\WHT\Chainage-Sequence](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\WHT\Chainage-Sequence) | \*Adding elements excavation with *Actual* and *Weekly* Date (one .csv per route) |
|  | 12) WHT\_ElemDatePOWID.csv | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\WHT\WHT\_ElemDatePOWID.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\WHT\WHT_ElemDatePOWID.csv) | \*Adding POW-ID and Name as per Weekly Date |

**Task 3 (Step 6) Link Construction Sequence from Elements to Nodes**

Python: nodal\_linking\_HT.py

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  | Note |
| Input files | 5) all\_data\_v2.csv | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\all\_data\_v2.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\all_data_v2.csv) | \*Elements and respective nodes |
|  | 12) WHT\_ElemDatePOWID.csv | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\WHT\WHT\_ElemDatePOWID.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\WHT\WHT_ElemDatePOWID.csv) | \*Grouped elements according to chainage |
|  | 13) mapped\_nodes.csv | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\mapped\_nodes.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\mapped_nodes.csv) | \* FEFLOW node coordinates |
| Output files | 14) WHT\_NodeDatePOWID.csv | [O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\WHT\WHT\_NodeDatePOWID.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\WHT\WHT_NodeDatePOWID.csv) |  |

**Task 3 (Step 7) Generate POW file**

Python: write\_TimeSeries\_pow.py

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  | Note |
| Inputs | First Date | First Date of Excavation from ‘DailyHeaderLocation’ file | \*read from 10-sequence.csv |
|  | Excav Date | Date of Excavation for element | \*read from 10-sequence.csv |
|  | End Date | End date of model (120 years in future) | \* Manual input |
| Output files | 10) WHT-RIC\_Geom-RevA\_ExcavationSequence.pow | [O:\PSM3696\Eng\20 HIR\FEFLOW\PostAudit\import+export\PowerFunctions\WHT-RIC\_Geom-RevA\_ExcavationSequence.pow](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\PostAudit\import+export\PowerFunctions\WHT-RIC_Geom-RevA_ExcavationSequence.pow) | \* ID = Week  [100-225]  \* Name = DateNum |

**RIC results**

Folder:[\\anf.psm.local\anf-files02\3000\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Test\ric\_conseq](file:///\\anf.psm.local\anf-files02\3000\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Test\ric_conseq)

**(Tunnels) Sequence -** **Node**

[O:\PSM3696\Eng\20 HIR\FEFLOW\PostAudit\conceptual\ExcavationSequence\RIC\_Geom-rev2\_Concept-rev2\_NodeProperties-Rev2-JY.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\PostAudit\conceptual\ExcavationSequence\RIC_Geom-rev2_Concept-rev2_NodeProperties-Rev2-JY.csv)

**[POW Function]**

[O:\PSM3696\Eng\20 HIR\FEFLOW\PostAudit\import+export\PowerFunctions\RIC\_Geom-RevA\_ExcavationSequence\_modulation.pow](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\PostAudit\import+export\PowerFunctions\RIC_Geom-RevA_ExcavationSequence_modulation.pow)

**WHTS results**

Folder:[O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\WHT\results](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\WHT\results)

**[Tunnels] Sequence -** **Element**

[O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\WHT\WHT\_ElemDatePOWID.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\WHT\WHT_ElemDatePOWID.csv)

**[Tunnels] Sequence -** **Node**

O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\WHT\WHT\_NodeDatePOWID.csv

**[Cut and cover] Sequence - Element**

[O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\CutnCover\Output\pythonoutputs\CutnCoverAssignedPOW\_JY.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\CutnCover\Output\pythonoutputs\CutnCoverAssignedPOW_JY.csv)

**[Cut and cover] Sequence - Node**

[O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\CutnCover\Output\pythonoutputs\CutnCoverNodePOW\_JY.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\CutnCover\Output\pythonoutputs\CutnCoverNodePOW_JY.csv)

**[SHAFTC] Sequence - Element**

[O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\CutnCover\Output\pythonoutputs\SHC\_AssignedPOW\_JY.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\CutnCover\Output\pythonoutputs\SHC_AssignedPOW_JY.csv)

**[SHAFTC] Sequence - Node**

[O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\CutnCover\Output\pythonoutputs\SHC\_NodePOW\_JY.csv](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\CutnCover\Output\pythonoutputs\SHC_NodePOW_JY.csv)

**[POW Function]**

[O:\PSM3696\Eng\20 HIR\FEFLOW\Mesh\Construction sequence\WHT\WHT\_TimeSeries\_modulation.dat](file:///O:\PSM3696\Eng\20%20HIR\FEFLOW\Mesh\Construction%20sequence\WHT\WHT_TimeSeries_modulation.dat)