



## Negative Flow Errors FAQ

Negative flow errors occur during HVAC system sizing calculation and/or energy simulation. They are a result of a mismatch in airflows.

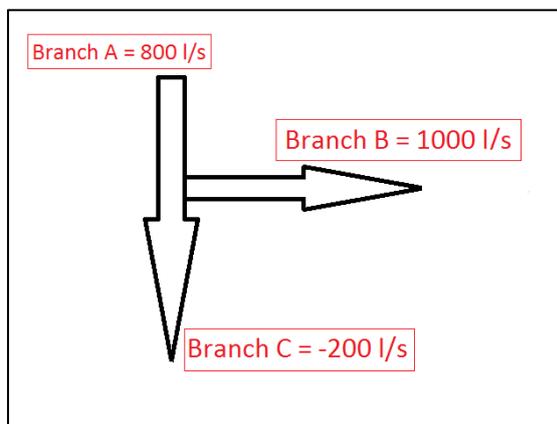


Fig 1: Negative flow schematic

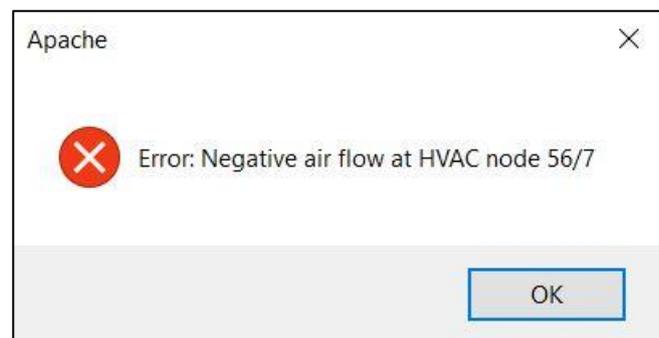


Fig 2: Negative flow error

As seen in the Fig 1, such a combination of airflows will lead to negative flow error at the intersection of branch B and C.

Fig 2 shows a typical negative flow error. This error is read as negative flow at node 56 of layer 7 of the multiplex. Users can easily locate the node using network check and find node icons on ApHVAC toolbar. Note that user first needs to click on 'network check' to activate the 'find node' option. With this functionality, the relevant node is highlighted in red.

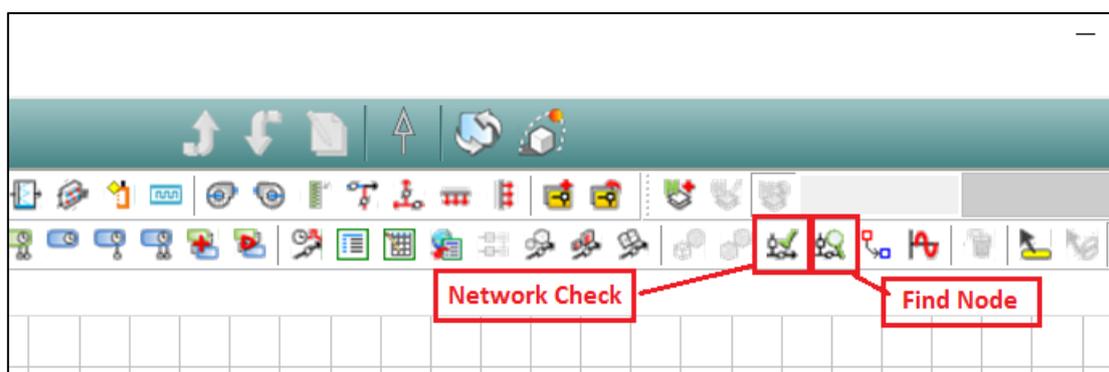


Fig 3: Network check and find node

With reference to fig 4, the two most common locations for negative flow errors are:

1. Node 56: Between primary air and exhaust airflow paths
2. Node 71: Between transfer and return airflow paths

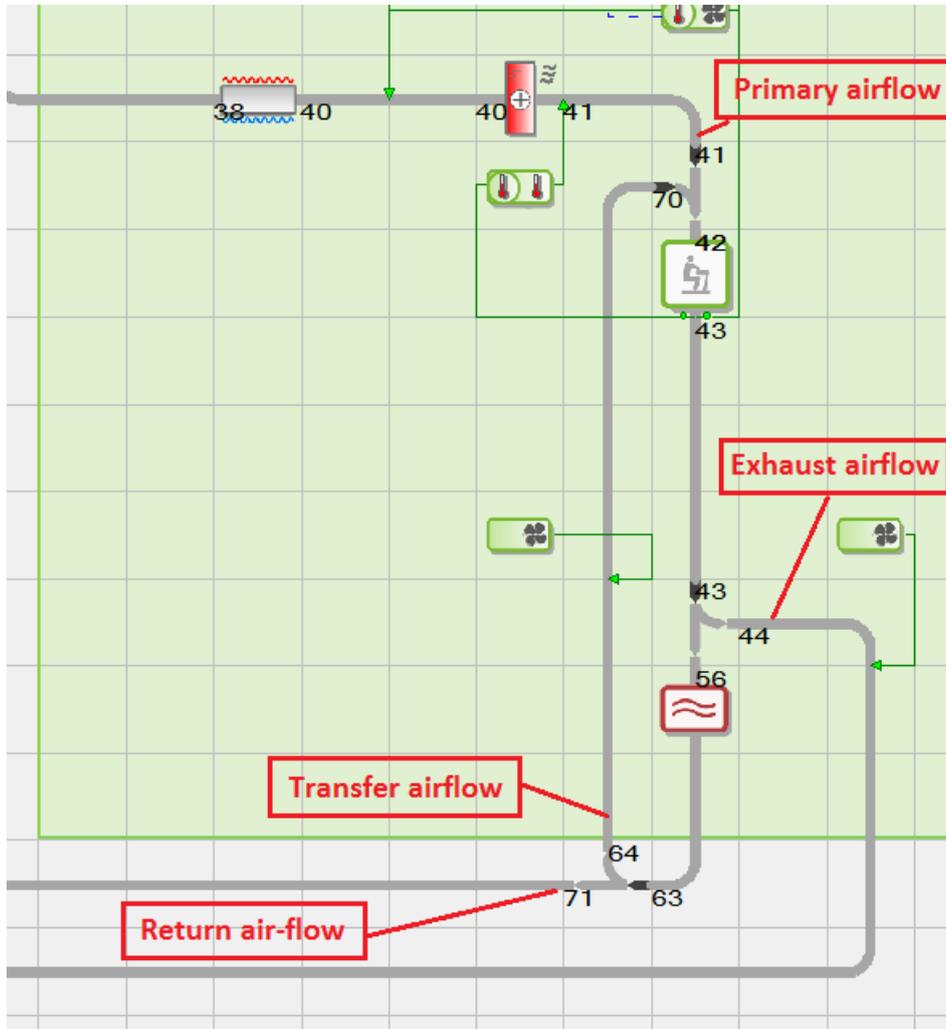


Fig 4: Airflow paths for a system 07a



## Troubleshooting tips

### 1. Negative flow error at exhaust airflow branch

Exhaust airflow rate can be viewed and edited in the 'room ventilation and exhaust' section of system parameter. In this case, exhaust air flowrate is greater than supply air flow rate. Possible solutions are as follows:

- Under make up air options, select '100% primary air'. This ensures primary (supply) air flow rate is increased to match exhaust requirement. Users can check the increased primary airflow in the mixed air damper minimum flow rate value.
- Check the box for 'Force outside air ventilation requirement to at least equal exhaust airflow'. As the option suggests, this increases the outside air flow rate to match the exhaust flow rate.

User has to 'assign' or 'assign and exit' the system parameters dialogue to push these commands on to the controllers in the network. Also make sure the links in the controllers are intact. If the link on the controllers and/or network components like mixing dampers is set to '<none>', then these changes in system parameters would not get assigned.

Air-change requirements, exhaust and transfer air

ASHRAE 170 function category: -

Primary air-change requirement: - cfm

Nighttime setback percentage of required primary airflow: - %

Exhaust air-change requirement: 1000.00 cfm 1000 cfm

ASHRAE 62.1 EA occupancy: - units

Force room outside-air ventilation requirement at least equal to exhaust airflow

Force room exhaust airflow at least equal to outside-air ventilation requirement

Make-up 100% primary air (constrained min SA flow rate) - %

Exhaust airflow 100% transfer air (transfer = exhaust) 1000 cfm  
Transfer air makes up difference between EA and SA  
Includes fixed percentage transfer air

Room air supply is 100% transfer air (RA and/or EA path, but no primary air supply)

Supply includes transfer in addition to primary air (% > min SA): - %

Transfer at max EA and min primary airflow: 0 cfm

Fig 5: Air change requirement, exhaust and transfer air section of system parameters



## 2. Negative flow error at transfer airflow branch

The two conditions mentioned below lead to negative flow error at transfer airflow branch.

### a. Space has exhaust requirement completely or partially met by transfer air

Negative flow error at the transfer airflow branch will be typically seen when a space has exhaust airflow requirement and make up air for exhaust is completely or partially transfer air. Spaces like restrooms, janitor closets etc. are typically conditioned with transfer air. In this case, the user may have chosen '100% transfer air', 'transfer makes up the difference between SA and EA' or 'includes fixed percentage of transfer air' as the make-up air option. A negative flow error suggests insufficient primary air to meet transfer and exhaust requirements. Note node 71 in fig 4 is outside the multiplex. This suggest the return air from all layers of the multiplex is collected at node 63 and then enters the transfer air loop. For error-free operation, the following condition has to be met.

$$S(\text{Primary airflow rate} - \text{exhaust airflow rate})_{\text{all layers}} \geq S(\text{transfer airflow rate})_{\text{all layers}}$$

The solution in this case is therefore to increase the primary air flow rate to satisfy the above mentioned condition.

### b. Space is conditioned by 100% transfer air

In this case, user should have checked the box for 'Room air supply is 100% transfer air (RA or EA path but no primary air supply)'. The solution here is again to increase the primary air flow rate.

Other commonly observed reasons for negative flow errors:

## 3. Fan powered boxes

HVAC systems with parallel or series fan powered boxes offer another unique case. User needs to define the airflow to be recirculated in the fan powered box as a percentage of primary air. This option is available in 'Room airflows, turndown and engineering checks' dialogue box of system parameters. A higher percentage forces more airflow through the fan powered boxes and subsequently leaves less primary air available for exhaust and transfer. The solution in this case is to lower the percentage recirculation value.

## 4. Incorrect profiles

If a user has defined exhaust or transfer air flowrates, the profiles in the relevant controllers of the network need to be checked. The time switch profile for transfer and exhaust airflow has to match that of primary airflow. The profile for primary airflow can be seen in mixing/outside air damper dialogue box. A mismatch in profiles leads to negative flow error. The above mentioned profiles match in all prototype systems from ApHVAC library. Exhaust/transfer airflow controller profile incorrectly set to 'on continuously' is a common issue seen with customized systems.