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# Compilation of Instantaneous Source Functions for Varying Architecture of a Layered Reservoir with Mixed Boundaries and Horizontal Well Completion
## Part IV: Normal and Inverted Letter 'h' and 'H' Architecture

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***Abstract***

***Instantaneous source functions of a two-layered reservoir with letters 'h and 'H' architectures have been derived. Thirty-two (32) different models, with different variations of sealing and constant-pressure external boundaries were used. The results are tabulated for quick reference.***

**Introduction**
As in the other architectures considered in this series, reservoir heterogeneity may give rise to an 'h' or 'H' letter architecture if the reservoir has two prolific compartments (layers). Horizontal or lateral wells will be excellent choices of wells to produce oil from such a layered reservoir. For several uses that may be necessary, instantaneous source functions are derived in this paper for the layers of the reservoir, considering fluid injection or influx. The source functions are derived from Refs. 1 and 2 as in Parts I to III.

**Normal and Inverted Letter 'h' and 'H' Two-Layered Reservoir Description**
**Fig. 1** below is a two-layered reservoir with normal letter 'h' or 'H' architecture. Each layer is completed with horizontal or lateral well. The top layer has one boundary that may be sealed or constant-pressured (fluid injection or influx), while the other two boundaries is 'infinitely far away' the bottom layer has two vertical boundaries that may be sealed or constant-pressure and one boundary is 'infinitely far away'. **Fig. 2** shows inverted letter 'h' architecture obtained through horizontal inversion of the normal letter 'h'. the horizontal inversion merely turns the top of a horizontal or lateral well bottom and bottom top. If well transients are not felt by the boundaries then the normal and inverted architectures will not be distinguishable. If the boundaries are felt, then appropriate source functions have to be selected to represent the process, as will be shown later.
Vertical inversions of normal and horizontally inverted architectures produce new architectures that turn bottom layers top layers and top layers bottom layers as shown below in **Fig. 3**. Therefore instantaneous source functions will be derived for one vertically inverted architecture and a mastery of the source selection process would make selection for their 'mirror images' very easy.
The architecture with capital letter 'H' system and its inversions are shown in **Fig.4**. Vertical inversion does not produce any change in boundary arrangement for both sealed and constant-pressure boundaries. But there are four (4) external boundaries that may be sealed or constant-pressured. Horizontal inversion merely turns horizontal well top bottom and bottom top, except for completely sealed or constant-pressured external boundaries, where the top layer is turned bottom and vice versa.

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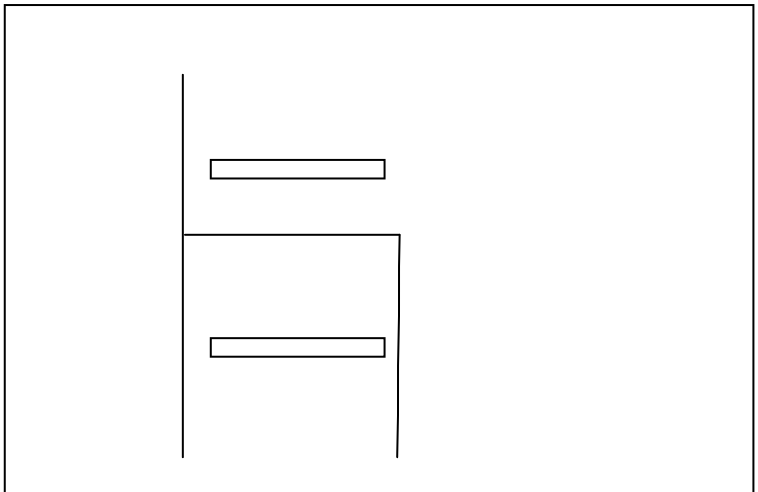

Fig. 1: A Two-Layered Reservoir with Normal Letter ‘h’

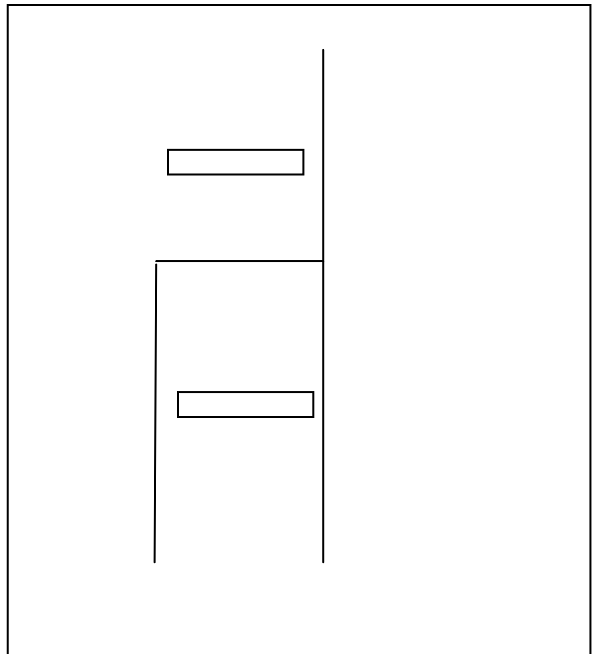

Fig. 2: A Two-Layered Reservoir with Horizontally Inverted Letter ‘h’ Architecture

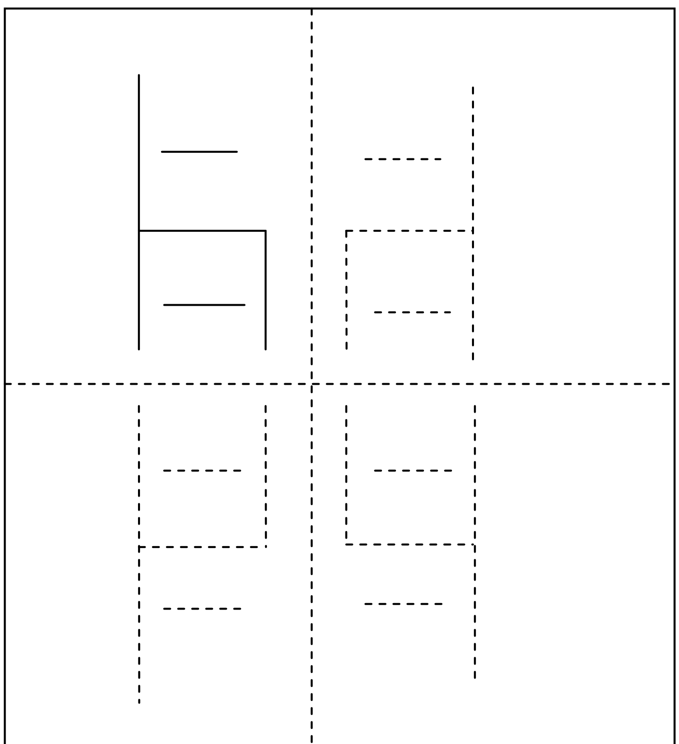

Fig. 3: Horizontally and Vertically Inverted Normal Letter ‘h’ Two-Layered Reservoir Architecture

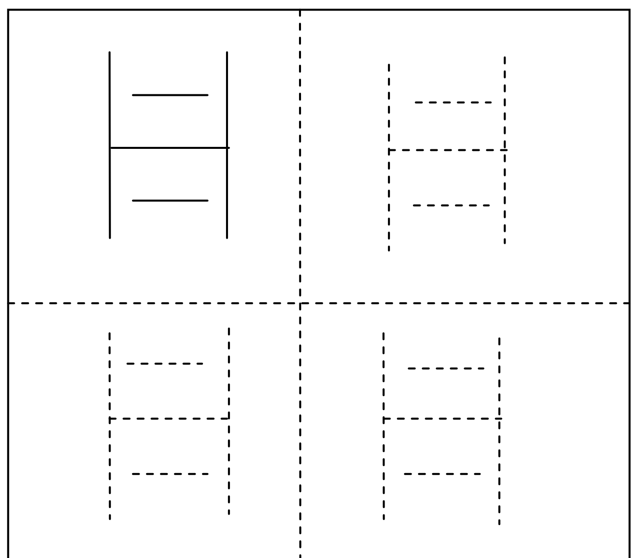

Fig. 4: Normal and Inverted Letter ‘H’ Two-Layered Reservoir Architecture

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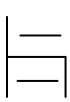
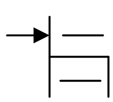
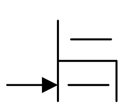
**Results and Discussion**

The interface is considered as a constant-pressure boundary throughout the derivation and is considered as permeable. Fluid influx and injection were varied on the external boundaries except 'infinitely far away' boundaries. The constants $E_1$ and $E_2$ in the instantaneous source functions can be used to determine the actual combined effect of fluid dynamics in the layers occurring at the interface. Line source horizontal or lateral wells are considered, hence, all the source functions along the y-axes are infinite. In writing down instantaneous source functions, central and off-central well locations along the x-axes are considered especially where there is no constant-pressure boundary. For instance, in Models no. 1, 15 and 16, both near boundaries along x-axes and absence of these boundaries are considered. Absence of these boundaries means that the well is infinite-acing. Even if the effect of one near boundary is felt, the instantaneous source function is written down to show that a 'pseudosealing' boundary is set up at late time, which limits the sweep area of the well. Thus action accelerates attainment of pseudosteady state (reservoir depletion) even though the reservoir is large enough for prolong oil production if the well is completed far away from the sealing boundary. On the other hand, fewer instantaneous source functions are written for layers with constant-pressure boundaries owing to the fact that external fluids precipitate steady-state once they are felt.

Results of all the possible instantaneous source functions are shown in **Table 1**. Thirty-two (32) different models were identified, comprising (1) normal (2) vertically inverted small letter 'h' architectures and capital letter 'H' architectures. The tops of all the normal and the bottoms of all the vertically inverted letter 'h' architectures have, along the x-axes, 'infinitely far away' and one sealed or constant-pressured pair of external boundaries. Furthermore, the bottoms of all the normal and tops of all the vertically inverted latter 'h' architectures have a pair of external boundaries, which may be sealed or constant-pressured. In other words, the normal and inverted letter 'h' architectures have three (3) external boundaries, which may be sealed or constant-pressured. However, there are four (4) external boundaries that may be sealed or constant-pressured in the letter 'H' architecture. The norm; letter 'H' architecture produces inversions which are identical to the normal for all sealing and all constant-pressured external boundaries, but turns all top layers bottom and vice versa for all vertically inverted letter 'H' architectures. For horizontally inverted letter 'H' architectures, all the well tops are turned bottoms, and vice versa.

In both latter 'h' and 'H' architectures, all the tops of Layer 2 and bottoms of Layer 1 are 'infinitely far away' external boundaries. Hence, all the source functions along the z-axes are the same, and therefore of the same kind, I(z). if transients reach the interface first, then infinite-acting flow would cease and steady-state would set in. since the interface might be felt first (and the infinite boundary never felt), source functions for z-axes v(z) are suggested for Layer 1 and vi(z) for Layer 2.

**Table 1: Description of Relevant Source Functions**

| S/N | Model Diagram | Instantaneous Source Function | | | |
|---|---|---|---|---|---|
| | | **x-axis** | **z-axis** | **Layer 1** | **Layer 2** |
| 1. |  | Top layers, sealed bottom, infinite top. Bottom layer, sealed ends | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).I(z)<br>$E_1$vii(x).I(y).I(z)<br>$E_1$vii(x).I(y).v(z)<br>$E_1$iii(x).I(y).I(z)<br>$E_1$iii(x).I(y).v(z) | $E_2$II(x).I(y).vi(z)<br>$E_2$vii(x).I(y).I(z)<br>$E_2$iii(x).I(y).I(z)<br>E2vii(x).I(y).vi(z)<br>$E_2$II(x).I(y).I(z) |
| 2. |  | Top layer, constant-pressure at bottom, infinite top. Bottom layer, sealed ends | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).I(z)<br>$E_1$vii(x).I(y).I(z)<br>$E_1$vii(x).I(y).v(z)<br>$E_1$iii(x).I(y).I(z)<br>$E_1$iii(x).I(y).v(z) | $E_2$II(x).I(y).I(z)<br>$E_2$vi(x).I(y).I(z)<br>$E_2$II(x).I(y).vi(z) |
| 3. |  | Top layer, sealed bottom, infinite top. Bottom layer, constant-pressure at bottom, sealed top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).I(z)<br>$E_1$vi(x).I(y).I(z)<br>$E_1$II(x).I(y).v(z) | $E_2$II(x).I(y).vi(z)<br>$E_2$vii(x).I(y).I(z)<br>$E_2$iii(x).I(y).I(z)<br>E2vii(x).I(y).vi(z)<br>$E_2$II(x).I(y).I(z) |

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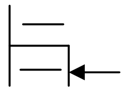
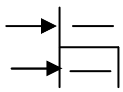
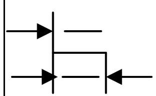
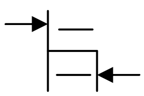
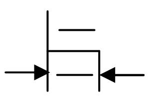
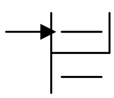
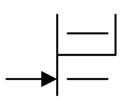
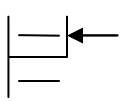
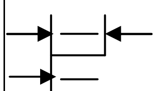
|---|---|---|---|---|---|
| 4. |  | Top layer, sealed bottom, infinite top. Bottom layer, sealed bottom, constant-pressure at top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1V(x).I(y).I(z)$<br>$E_1II(x).I(y).I(z)$<br>$E_1II(x).I(y).v(z)$ | $E_2II(x).I(y).I(z)$<br>$E_2vi(x).I(y).I(z)$<br>$E_2II(x).I(y).vi(z)$ |
| 5. |  | Top layer, constant-pressure at bottom, infinite top. Bottom layer, constant-pressure at bottom, sealed top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1II(x).I(y).I(z)$<br>$E_1vi(x).I(y).I(z)$<br>$E_1II(x).I(y).v(z)$ | $E_2II(x).I(y).I(z)$<br>$E_2vi(x).I(y).I(z)$<br>$E_2II(x).I(y).vi(z)$ |
| 6. |  | Top layer, constant-pressure at bottom, infinite top. Bottom layer, constant-pressure at both ends | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1viii(x).I(y).I(z)$<br>$E_1II(x).I(y).I(z)$<br>$E_1II(x).I(y).v(z)$ | $E_2II(x).I(y).I(z)$<br>$E_2vi(x).I(y).I(z)$<br>$E_2II(x).I(y).vi(z)$ |
| 7. |  | Top layer, constant-pressure at bottom, infinite top. Bottom layer, sealed bottom, constant-pressure at top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1V(x).I(y).I(z)$<br>$E_1II(x).I(y).I(z)$<br>$E_1II(x).I(y).v(z)$ | $E_2II(x).I(y).I(z)$<br>$E_2vi(x).I(y).I(z)$<br>$E_2II(x).I(y).vi(z)$ |
| 8. |  | Top layer, sealed bottom, infinite top. Bottom layer, constant-pressure at both ends | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1viii(x).I(y).I(z)$<br>$E_1II(x).I(y).I(z)$<br>$E_1II(x).I(y).v(z)$ | $E_2II(x).I(y).I(z)$<br>$E_2vi(x).I(y).I(z)$<br>$E_2II(x).I(y).vi(z)$ |
| 9. |  | Top layer, constant-pressure at bottom, sealed top. Bottom layer, sealed bottom, infinite top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1II(x).I(y).v(z)$<br>$E_1vii(x).I(y).I(z)$<br>$E_1iii(x).I(y).v(z)$<br>$E_1vii(x).I(y).v(z)$ | $E_2II(x).I(y).I(z)$<br>$E_2vi(x).I(y).I(z)$<br>$E_2II(x).I(y).vi(z)$<br>$E_2vi(x).I(y).vi(z)$ |
| 10. |  | Top layer, sealed ends. Bottom layer, constant-pressure at bottom, infinite top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1II(x).I(y).v(z)$<br>$E_1vii(x).I(y).I(z)$<br>$E_1iii(x).I(y).I(z)$<br>$E_1vii(x).I(y).v(z)$<br>$E_1II(x).I(y).I(z)$ | $E_2II(x).I(y).I(z)$<br>$E_2vii(x).I(y).I(z)$<br>$E_2vii(x).I(y).v(z)$<br>$E_2iii(x).I(y).I(z)$<br>$E_2iii(x).I(y).v(z)$ |
| 11. |  | Top layer, sealed bottom, constant-pressure at top. Bottom layer, sealed bottom, infinite top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1II(x).I(y).v(z)$<br>$E_1vii(x).I(y).I(z)$<br>$E_1iii(x).I(y).v(z)$<br>$E_1vii(x).I(y).v(z)$ | $E_2v(x).I(y).I(z)$<br>$E_2II(x).I(y).I(z)$<br>$E_2II(x).I(y).v(z)$ |
| 12. |  | Top layer, constant-pressure at both ends. Bottom layer, constant-pressure at bottom, infinite top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1II(x).I(y).v(z)$<br>$E_1vii(x).I(y).I(z)$<br>$E_1iii(x).I(y).I(z)$<br>$E_1vii(x).I(y).v(z)$<br>$E_1II(x).I(y).I(z)$ | $E_2viii(x).I(y).I(z)$<br>$E_2II(x).I(y).I(z)$<br>$E_2II(x).I(y).v(z)$ |

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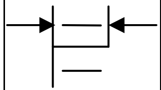
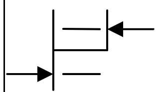
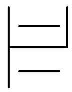
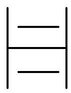
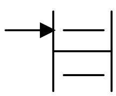
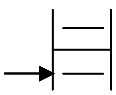
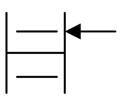
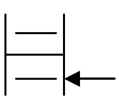
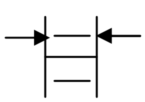
| 13. |  | Top layer, constant-pressure at both ends. Bottom layer, sealed bottom, infinite top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).v(z)<br>$E_1$vii(x).I(y).I(z)<br>$E_1$iii(x).I(y).I(z)<br>$E_1$vii(x).I(y).v(z)<br>$E_1$II(x).I(y).I(z) | $E_2$v(x).I(y).I(z)<br>$E_2$II(x).I(y).I(z)<br>$E_2$II(x).I(y).v(z) |
| 14. |  | Top layer, sealed bottom, constant-pressure at top. Bottom layer, constant-pressure at bottom, infinite top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).v(z)<br>$E_1$vii(x).I(y).I(z)<br>$E_1$iii(x).I(y).v(z)<br>$E_1$vii(x).I(y).v(z) | $E_2$II(x).I(y).I(z)<br>$E_2$vii(x).I(y).I(z)<br>$E_2$vii(x).I(y).v(z)<br>$E_2$iii(x).I(y).I(z)<br>$E_2$iii(x).I(y).v(z) |
| 15. |  | Top layer, sealed ends. Bottom layer, sealed bottom, infinite top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).v(z)<br>$E_1$vii(x).I(y).I(z)<br>$E_1$iii(x).I(y).I(z)<br>$E_1$vii(x).I(y).v(z)<br>$E_1$II(x).I(y).I(z) | $E_2$II(x).I(y).I(z)<br>$E_2$vi(x).I(y).I(z)<br>$E_2$II(x).I(y).vi(z)<br>$E_2$vi(x).I(y).vi(z) |
| 16. |  | Top and bottom layers, sealed ends | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).I(z)<br>$E_1$vii(x).I(y).I(z)<br>$E_1$vii(x).I(y).v(z)<br>$E_1$iii(x).I(y).I(z)<br>$E_1$iii(x).I(y).v(z) | $E_2$II(x).I(y).I(z)<br>$E_2$vii(x).I(y).I(z)<br>$E_2$vii(x).I(y).v(z)<br>$E_2$iii(x).I(y).I(z)<br>$E_2$iii(x).I(y).v(z) |
| 17. |  | Top layer, constant-pressure at bottom, sealed top. Bottom layer, sealed ends | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).v(z)<br>$E_1$vii(x).I(y).I(z)<br>$E_1$iii(x).I(y).v(z)<br>$E_1$vii(x).I(y).v(z) | $E_2$II(x).I(y).I(z)<br>$E_2$vii(x).I(y).I(z)<br>$E_2$vii(x).I(y).v(z)<br>$E_2$iii(x).I(y).I(z)<br>$E_2$iii(x).I(y).v(z) |
| 18. |  | Top layer, sealed ends. Bottom layer, constant-pressure at bottom, sealed top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).I(z)<br>$E_1$vii(x).I(y).I(z)<br>$E_1$vii(x).I(y).v(z)<br>$E_1$iii(x).I(y).I(z)<br>$E_1$iii(x).I(y).v(z) | $E_2$II(x).I(y).vi(z)<br>$E_2$vii(x).I(y).I(z)<br>$E_2$iii(x).I(y).I(z)<br>E2vii(x).I(y).vi(z)<br>$E_2$II(x).I(y).I(z) |
| 19. |  | Top layer, sealed bottom, constant-pressure at top. Bottom layer, sealed ends | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).v(z)<br>$E_1$vii(x).I(y).I(z)<br>$E_1$iii(x).I(y).v(z)<br>$E_1$vii(x).I(y).v(z) | $E_2$II(x).I(y).I(z)<br>$E_2$vii(x).I(y).I(z)<br>$E_2$vii(x).I(y).v(z)<br>$E_2$iii(x).I(y).I(z)<br>$E_2$iii(x).I(y).v(z) |
| 20. |  | Top layer, sealed ends. Bottom layer, sealed bottom, constant-pressure at top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).I(z)<br>$E_1$vii(x).I(y).I(z)<br>$E_1$vii(x).I(y).v(z)<br>$E_1$iii(x).I(y).I(z)<br>$E_1$iii(x).I(y).v(z) | $E_2$II(x).I(y).I(z)<br>$E_2$vi(x).I(y).I(z)<br>$E_2$II(x).I(y).vi(z) |
| 21. |  | Top layer, constant-pressure at both ends. Bottom layer, sealed ends | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).v(z)<br>$E_1$vii(x).I(y).I(z)<br>$E_1$iii(x).I(y).v(z)<br>$E_1$vii(x).I(y).v(z) | $E_2$v(x).I(y).I(z)<br>$E_2$II(x).I(y).I(z)<br>$E_2$II(x).I(y).v(z) |

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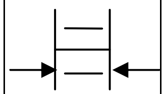
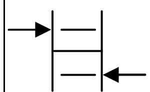
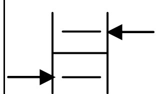
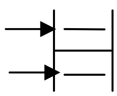
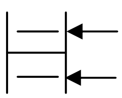
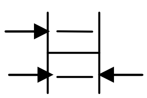
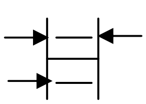
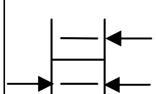
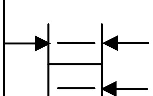
| 22. |  | Top layer, sealed ends. Bottom layer, constant-pressure at both ends | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$viii(x).I(y).I(z)<br>$E_1$II(x).I(y).I(z)<br>$E_1$II(x).I(y).v(z) | $E_2$II(x).I(y).I(z)<br>$E_2$vi(x).I(y).I(z)<br>$E_2$II(x).I(y).vi(z) |
| 23. |  | Top layer, constant-pressure at bottom, sealed top. Bottom layer, sealed bottom, constant-pressure at top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).I(z)<br>$E_1$vii(x).I(y).I(z)<br>$E_1$vii(x).I(y).v(z)<br>$E_1$iii(x).I(y).I(z)<br>$E_1$iii(x).I(y).v(z) | $E_2$II(x).I(y).I(z)<br>$E_2$vii(x).I(y).I(z)<br>$E_2$vii(x).I(y).v(z)<br>$E_2$iii(x).I(y).I(z)<br>$E_2$iii(x).I(y).v(z) |
| 24. |  | Top layer, sealed bottom, constant-pressure at top. Bottom layer, constant-pressure at bottom, sealed top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).I(z)<br>$E_1$vii(x).I(y).I(z)<br>$E_1$vii(x).I(y).v(z)<br>$E_1$iii(x).I(y).I(z)<br>$E_1$iii(x).I(y).v(z) | $E_2$II(x).I(y).I(z)<br>$E_2$vii(x).I(y).I(z)<br>$E_2$vii(x).I(y).v(z)<br>$E_2$iii(x).I(y).I(z)<br>$E_2$iii(x).I(y).v(z) |
| 25. |  | Both layers, constant-pressure at bottoms, sealed tops | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).I(z)<br>$E_1$vi(x).I(y).I(z)<br>$E_1$II(x).I(y).v(z) | $E_2$II(x).I(y).I(z)<br>$E_2$vii(x).I(y).I(z)<br>$E_2$vii(x).I(y).v(z)<br>$E_2$iii(x).I(y).I(z)<br>$E_2$iii(x).I(y).v(z) |
| 26. |  | Both layers, sealed bottoms, constant-pressure at tops | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$V(x).I(y).I(z)<br>$E_1$II(x).I(y).I(z)<br>$E_1$II(x).I(y).v(z) | $E_2$v(x).I(y).I(z)<br>$E_2$II(x).I(y).I(z)<br>$E_2$II(x).I(y).v(z) |
| 27. |  | Top layer, constant-pressure at bottom, sealed top. Bottom layer, constant-pressure at both ends | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$viii(x).I(y).I(z)<br>$E_1$II(x).I(y).I(z)<br>$E_1$II(x).I(y).v(z) | $E_2$II(x).I(y).I(z)<br>$E_2$vii(x).I(y).I(z)<br>$E_2$vii(x).I(y).v(z)<br>$E_2$iii(x).I(y).I(z)<br>$E_2$iii(x).I(y).v(z) |
| 28. |  | Top layer, constant-pressure at both ends. Bottom layer, constant-pressure at bottom, sealed top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).I(z)<br>$E_1$vi(x).I(y).I(z)<br>$E_1$II(x).I(y).v(z) | $E_2$v(x).I(y).I(z)<br>$E_2$II(x).I(y).I(z)<br>$E_2$II(x).I(y).v(z) |
| 29. |  | Top layer, sealed bottom, constant-pressure at top. Bottom layer, constant-pressure at both ends | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$viii(x).I(y).I(z)<br>$E_1$II(x).I(y).I(z)<br>$E_1$II(x).I(y).v(z) | $E_2$v(x).I(y).I(z)<br>$E_2$II(x).I(y).I(z)<br>$E_2$II(x).I(y).v(z) |
| 30. |  | Top layer, constant-pressure at both ends. Bottom layer, sealed bottom, constant-pressure at top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$V(x).I(y).I(z)<br>$E_1$II(x).I(y).I(z)<br>$E_1$II(x).I(y).v(z) | $E_2$v(x).I(y).I(z)<br>$E_2$II(x).I(y).I(z)<br>$E_2$II(x).I(y).v(z) |

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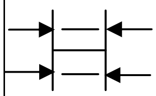
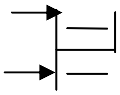
| 31. |  | Both layers, constant-pressure at both ends | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$viii(x).I(y).I(z)<br>$E_1$II(x).I(y).I(z)<br>$E_1$II(x).I(y).v(z) | $E_2$v(x).I(y).I(z)<br>$E_2$II(x).I(y).I(z)<br>$E_2$II(x).I(y).v(z) |
| 32. |  | Top layer, constant-pressure at bottom, sealed top. Bottom layer, constant-pressure at bottom, infinite top | Top layer, infinite top, interface bottom. Bottom layer, interface top, infinite bottom | $E_1$II(x).I(y).v(z)<br>$E_1$vii(x).I(y).I(z)<br>$E_1$iii(x).I(y).v(z)<br>$E_1$vii(x).I(y).v(z) | $E_2$viii(x).I(y).I(z)<br>$E_2$II(x).I(y).I(z)<br>$E_2$II(x).I(y).v(z) |

## Conclusion

Only transient pressure test analyses can satisfactorily reveal the architecture of a layered reservoir. Instantaneous source functions for all the possible normal and inverted models of both letters 'h' and 'H' architectures have been derived and tabulated for the construction of pressure distribution expressions required for formulating well test analysis procedures. The derivations show that for a two-layered reservoir with 'h' or 'H' architecture

1. There are three (3) external boundaries which may be sealed or constant-pressured in both normal or inverted letter 'h' architectures, and four (4) in letter 'H' architecture.
2. A total of thirty-two (32) different models are identifiable with variations of sealing and constant-pressure boundaries.
3. All the architectures possess 'infinitely far away' external boundaries along the z-axes, except the interface.
4. The letter 'H' architecture produces inversions which are identical to the normal for all sealing or constant-pressure external boundaries.
5. Horizontal inversions turn well tops bottoms and bottoms tops while vertical inversions turn Layer 1 Layer2 and Layer 2 Layer 1.

## Nomenclature

| | |
|---|---|
| $E_1$ | Late time flow boundary effects constant for Layer 1 |
| $E_2$ | Late time flow boundary effects constant for Layer 2 |
| (i) | Axial flow directions x, y, or z |
| i | Distances in x, y, or z directions, ft |

## References


[1] Carslaw, H.S. and Jaeger, J.C.: *Conduction of Heat through Solids*, 2nd Ed. Oxford University Press, London, England, 1959.

[2] Gringarten, A.C. and Ramey, H.J.Jr. (1973): "The Use of Source and Green's Functions in Solving Unsteady-Flow Problems in Reservoirs," SPE *Trans*.; AIME, 255-285.

[3] Adewole, E.S.: "Compilation of Instantaneous Source Functions for Varying Architecture of a Layered Reservoir with Mixed Boundaries and Horizontal Well Completion," Part I: 'E'-Shaped Architecture, paper submitted to *Nigeria Association of Mathematical Physics*, 2010.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