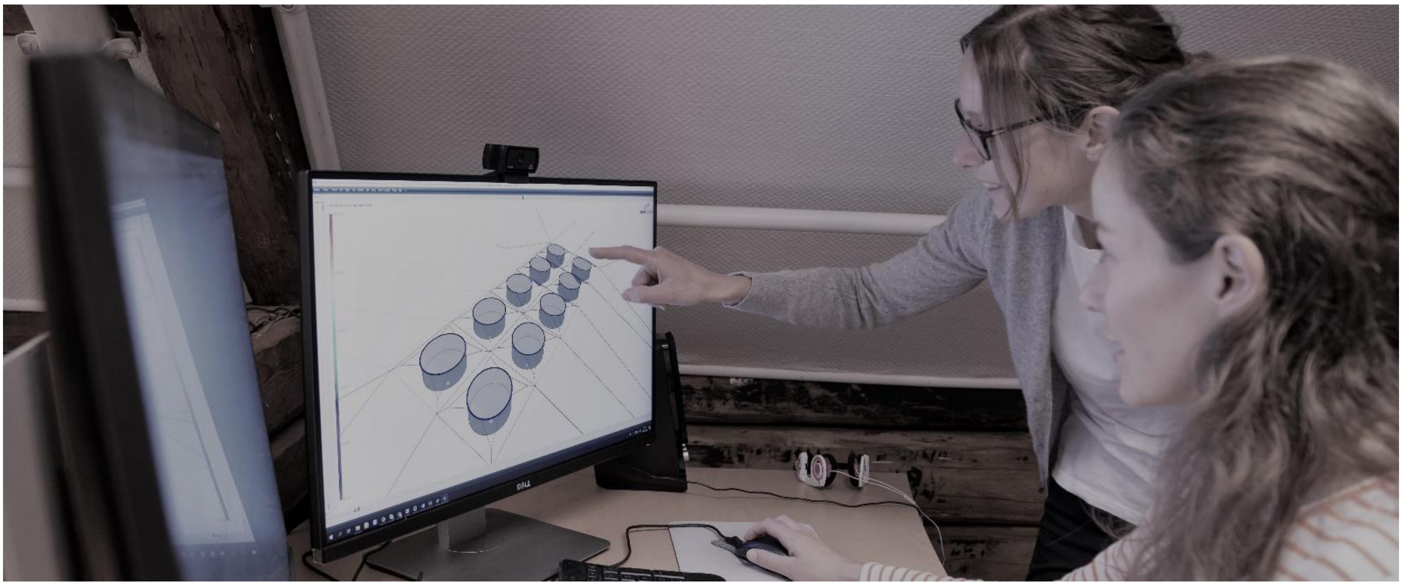
AquaSim training courses

- **Land-based Water Tank**



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Aquastructures AS
Kjøpmannsgata 21, 7013 Trondheim
Norway

Content

1 Prerequisites

It is assumed that the user is familiar with the basic principles of modelling and specifying material parameters in AquaEdit, as well as conducting analyses. If you are looking for an introduction to AquaSim we advise you to start with the Basic program tutorials.

2 Introduction

2.1 Learning objectives

Upon completion of this case study, you will be able to:

- Model a rigid, water-filled tank structure placed on land (on shore)
- Apply internal hydrostatic pressure from the contained water volume
- Define appropriate boundary conditions representing a land-based (fixed) support
- Understand how the absence of external buoyancy affects the load model compared to submerged structures
- Execute a static analysis and evaluate structural response in AquaView.

2.2 Introduction

This tutorial describes how to model and analyze a water-filled tank located on land. Unlike submerged or floating aquaculture structures, a land-based tank is not subject to external buoyancy or environmental waves- and current loads. Instead, the dominant load is the internal hydrostatic pressure from the water column contained within the tank, combined with the self-weight of the structure.

Correctly modelling the internal water pressure is essential to obtaining realistic structural results. In AquaSim, this is handled through the closed compartment functionality, where the internal fluid level and density are defined independently from the external environment. The tank structure itself is treated as a fixed, land-based assembly with boundary conditions constraining rigid body motion.

The case study serves as a practical introduction to land-based structural analysis in AquaSim and provides a basis for more complex scenarios, such as tanks subject to sloshing, partial fill levels, impact loads, or varying fluid densities.

3 Modelling.

A basic tank can be modelled using the tool **Generate Net** in AquaEdit, as shown in Figure 1.

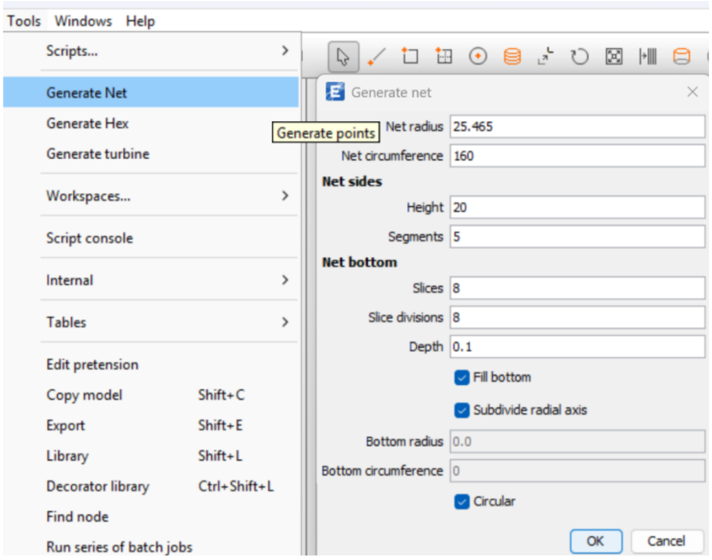

Figure 1 Generate net option in AquaEdit

The **Depth** parameter can be set to zero, or to a small value, in order to create a flat or nearly flat bottom surface for the tank. The generated geometry will then consist of both the side walls and the bottom, as illustrated in Figure 2. To represent a land-based tank (i.e. a structure located in air), the model should be positioned such that its baseline is at $z = 0$ or higher. This ensures that no external water loads are applied.

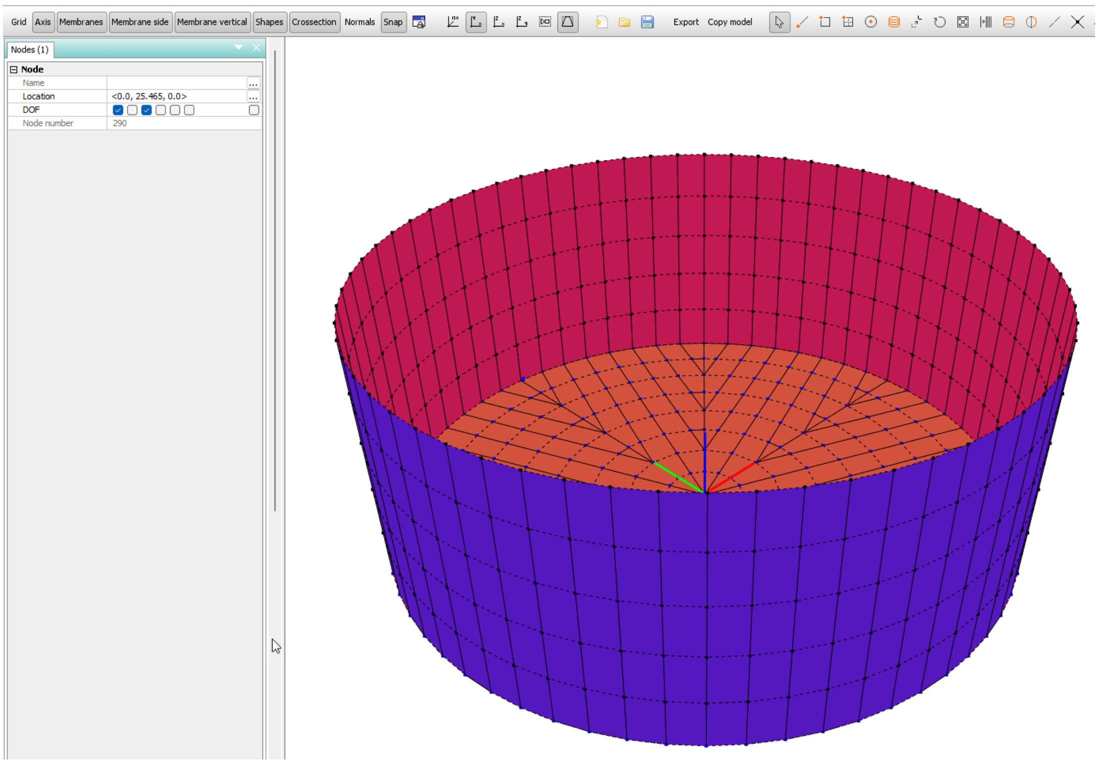

Figure 2 Tank walls and bottom modelled in AquaEdit

The orientation of the membrane panel is important to make sure that pressure is calculated correctly, in Figure 2 the option **Membrane side** is activated. The inside of the tank should have a shade of red color and the outside a shade of blue.

Enter the Edit membrane dialogue by double clicking the component in the Components section, as illustrated in Figure 3.

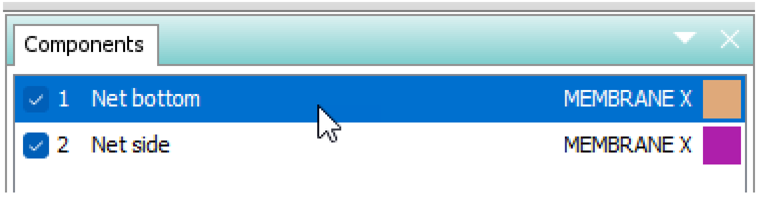

Figure 3 Enter Edit membrane dialogue

The membrane type should be **Shell**, and to include the effect of the water inside the tank, the **Closed Compartment** option must be activated. This enables AquaSim to calculate the internal hydrostatic pressure acting on the structure.

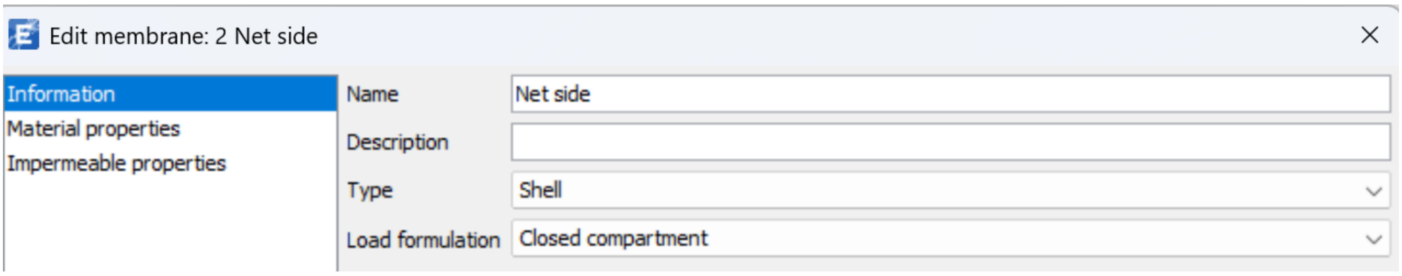

Figure 4 Shell properties and Close Compartment option

The tank dimensions used in this tutorial are given in Figure 5.

Shell properties	
E-module	1E10 N/m^2
Thickness	0.1 m
Poisson	0.4
Mass density	7850.0 kg/m^3
Relative density in water	6825.0 kg/m^3
No compression forces	
Added thickness coefficient	1.0
Pretension Y	0.0
Pretension Z	0.0

Figure 5 Tank dimensions

This tutorial focuses on a simple, unstiffened tank. The section properties in Figure 4 may be interpreted as equivalent values representing a full cross-section, including all layers in the case of composite construction, and accounting for stiffeners where relevant. More complex tank configurations are not covered here but can readily be modelled by applying standard AquaSim elements such as stiffened panels.

The parameters defining the internal fluid are shown in Figure 6:

- **Density of fluid inside enclosed volume** – the density of the water contained in the tank; in this case fresh water with a density of 1000 kg/m³.
- **Height of fluid** – the fluid level expressed relative to the coordinate system. For a fully filled tank, this equals the top of the tank, in this case z = 20 m.
- **Free surface area of internal waterline** – the area of the free water surface inside the tank; in this case 1963.5 m².

Fluid parameters internally in tank	
Density of fluid inside enclosed volume	1000.0 kg/m^3
Height of fluid level inside enclosed volume relative to s...	20.0 m
Free surface area of internal waterline	1963.5 m^2

Figure 6 Fluid parameters for the internal water volume

The nodes along the tank bottom are fixed in all DOFs, representing a rigid foundation support. This is illustrated in the left part of Figure 7

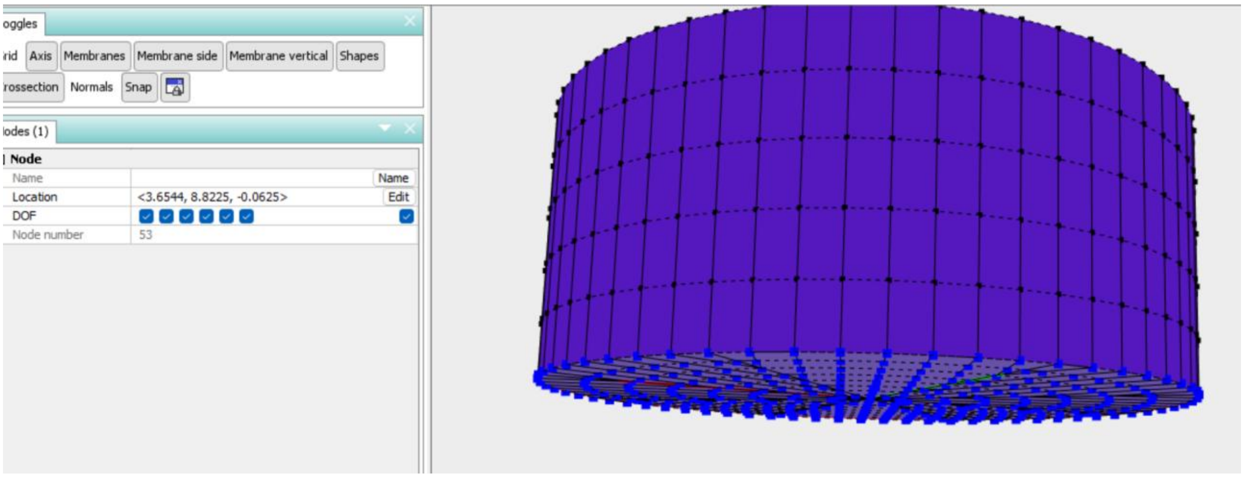

Figure 7 Fixed boundary conditions at tank bottom

The nodes along the upper rim are released in horizontal directions and in rotation, as shown in Figure 8.

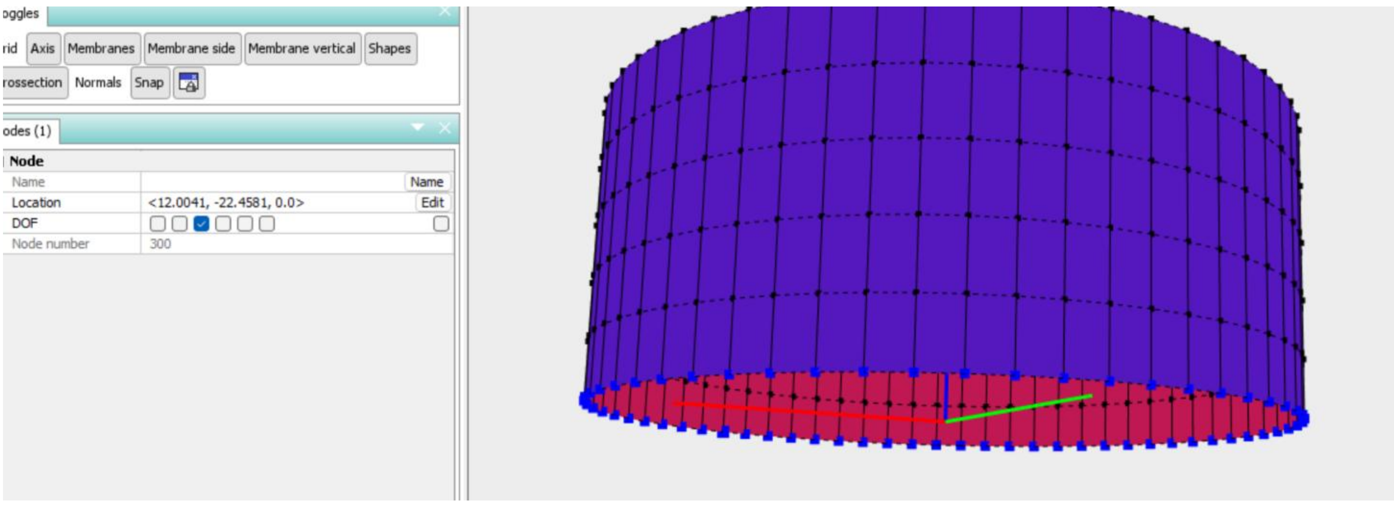

Figure 8 Boundary conditions at nodes along the rim

4 Analysis

A static analysis, whit Export parameters as shown in Figure 9.

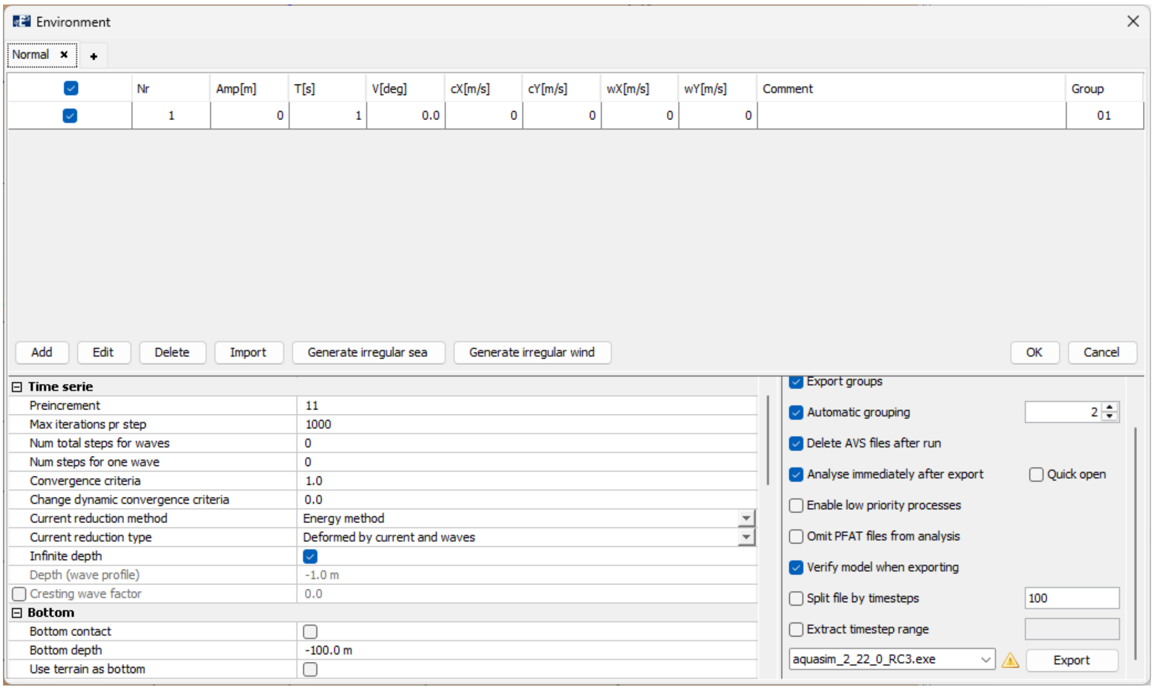

Figure 9 Export setting for AquaSim analysis

5 Results

When the analysis is completed, the results can be viewed by opening the analysis file *.avz in AquaView. Figure 10 shows the vertical position of the tank model when selecting Results > Location > Position Z [m].

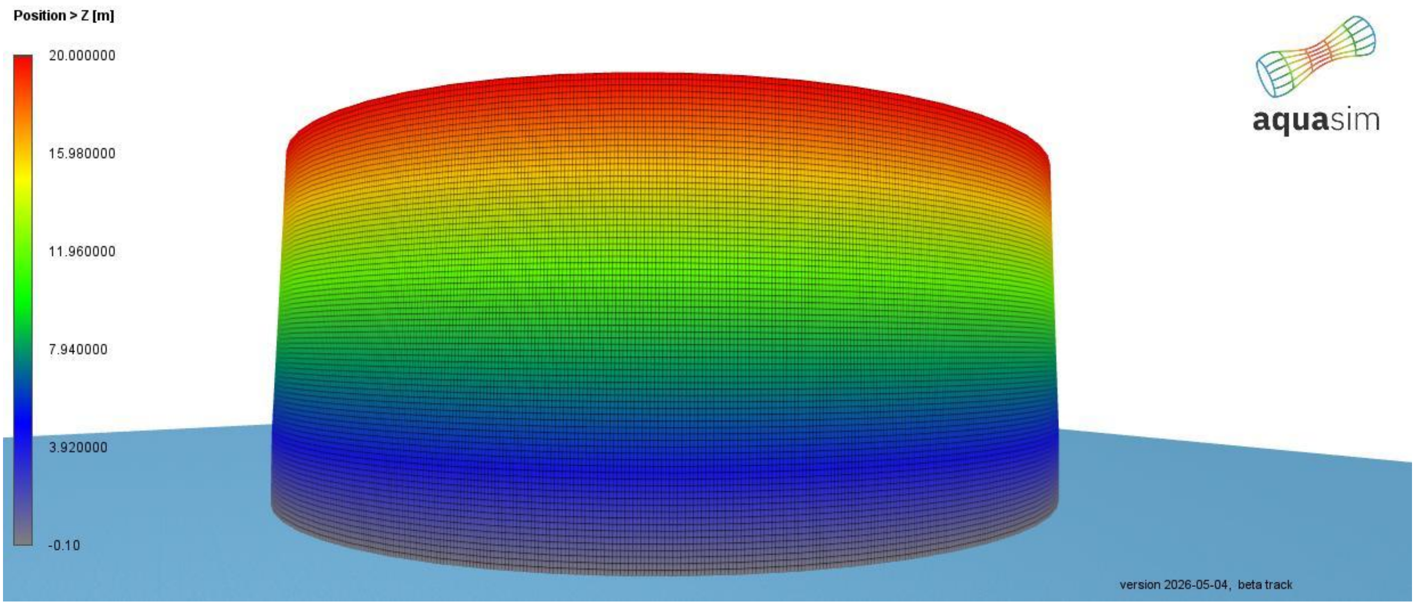

Figure 10 Vertical position of tank

Figure 11 shows the relative pressure at the center of each element. The pressure is evaluated at the element midpoint and color-mapped accordingly. Note that pressure from the outside is taken as positive, meaning the internal hydrostatic pressure acting outward on the tank wall is shown as negative relative pressure. As expected, the results correspond well with the theoretical hydrostatic distribution where pressure increases linearly with depth.

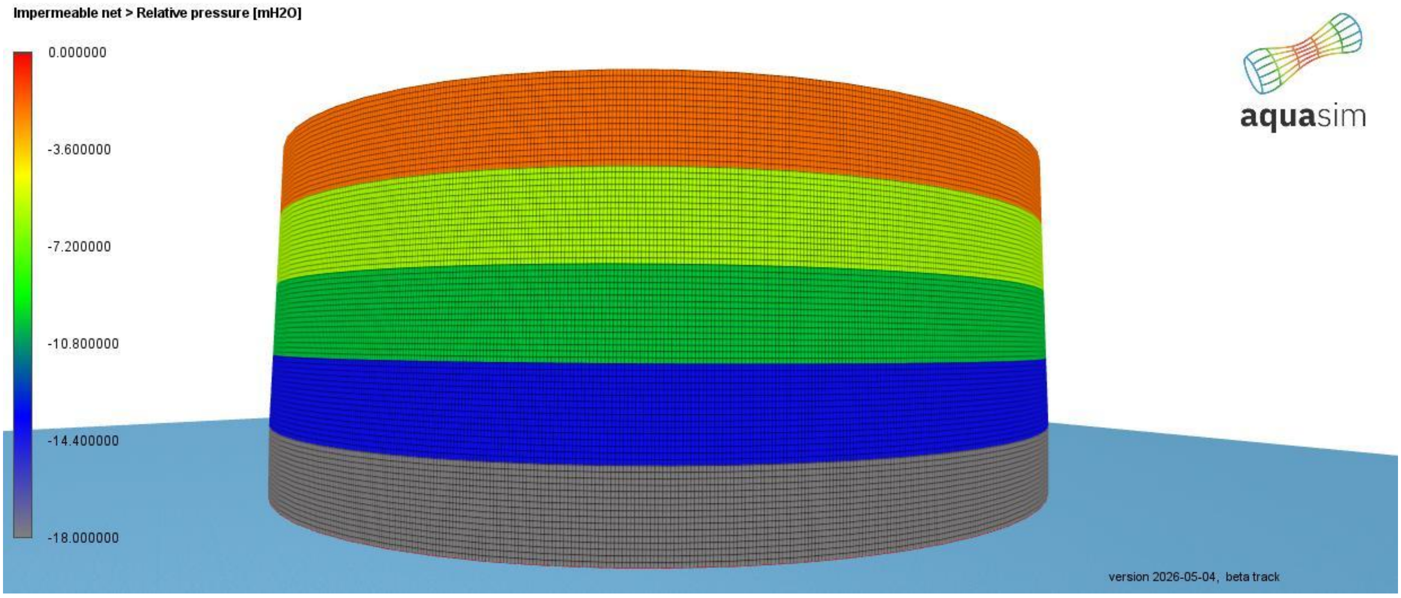

Figure 11 Relative pressure at element centres.

As seen from Figure 11 results correspond with location. Figure 12 shows the Von Mises stress distribution in the tank elements.

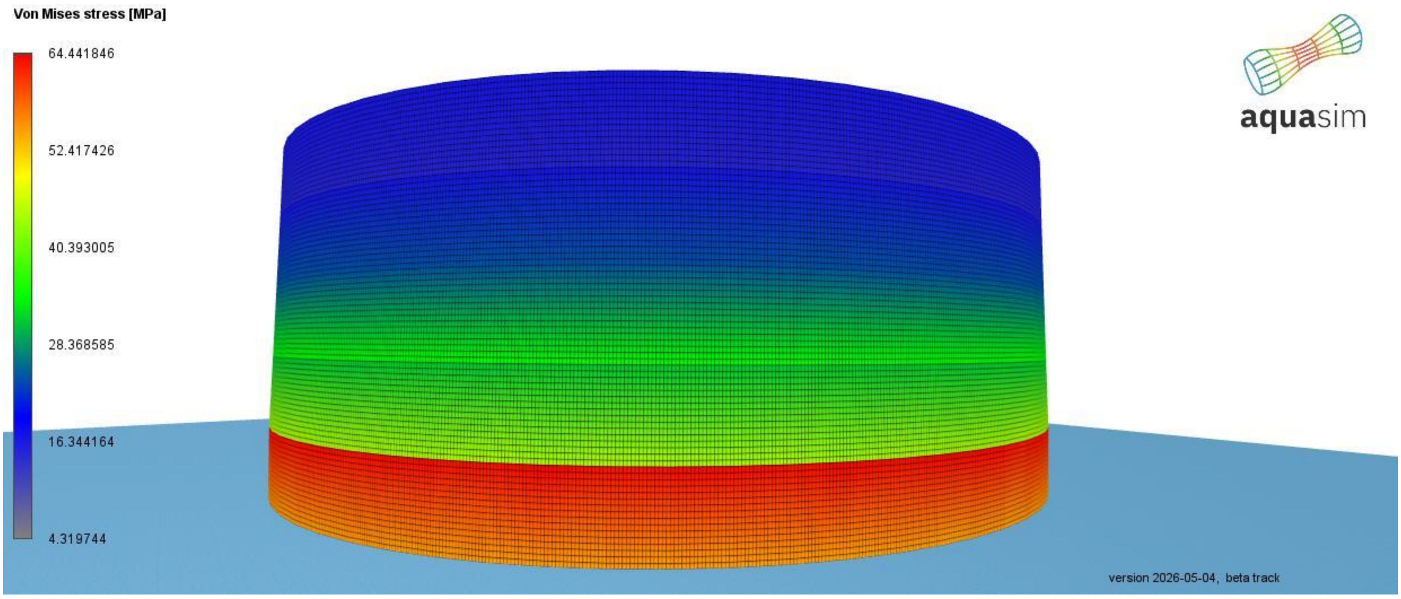

Figure 12 Von Mises stress

6 Summary

This tutorial has demonstrated how a water-filled, land-based tank can be modelled and analysed in AquaSim using membrane type Shell and the Close Compartment load formulation.

A cylindrical tank with a flat bottom was generated using the Generate Net option and positioned in air by placing the baseline at z = 0 or above. Shell properties were assigned to both the side walls and the bottom, and the internal water was defined through the enclosed volume parameters — specifying fluid density, fill height, and free surface area. Fixed boundary conditions were applied at the base nodes to represent a rigid foundation, while the rim nodes were released horizontally and rotationally to reflect realistic top-edge conditions.

The static analysis results confirm that the internal pressure distribution follows the expected hydrostatic pattern, with pressure increasing linearly from zero at the free surface to a maximum at the tank base. The Von Mises stress results provide a basis for structural assessment of the tank wall and bottom under the applied water load.

Although this tutorial covers a simple, unstiffened tank, the same modelling approach can be extended to more complex configurations. Additional structural details, such as stiffened panels, composite cross-sections, or partial fill levels, can be introduced using standard elements available in AquaSim.

7 Revision comments

Revision no.	Comment
1.0	First publication

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