120 FINCHLEY ROAD
LONDON
NW3 5JB

PROTECTION OF BASEMENT AGAINST WATER FROM THE GROUND

JRG/PC/8083 APRIL 2015

3 Dufferin Avenue,
Barbican, London, EC1Y 8PQ
T: 020 7253 2626
F: 020 7253 2767
E: tws@tws.uk.com
W: www.tws.uk.com

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1.00 INSTRUCTION

1.01 The basement is constructed on a site 18.73m wide and 53.6m long sloping from level 63.13 to level 53.81 at 1:6 approximately. The deepest depth of cut at the rear of the site at level 63.13 to 47.74 is 15.50m and the shallowest (at the road frontage) is 2m.

1.02 The ground conditions are approximately 1.0m of topsoil/made ground overlying London Clay.

1.03 The basement is formed from a mix of secant piles and contiguous piles at its deepest level and contiguous piles along the lower depths of the flanks and at the frontage to Finchley Road where the depth of excavation is only 6.5m.

1.04 The highest level of water table is at the top of the clay, i.e. 1m down.

1.05 The basement spaces are generally habitable dwellings except at the 1-storey deep frontage where they are mechanical plant.

2.00 DESIGN PHILOSOPHY

2.01 The guidance of BS 8102:2009 is to be followed.

2.02 Water pressure on the sides and underside of the basement is to be reduced by using drainage:

a) land drainage to prevent surface water build up at the deepest part of the basement.

b) sub-surface drainage to relieve hydrostatic pressure against the structure of the basement sides and underside.

2.03 Basement waterproofing protection to be commensurate with the risk.

3.00 RISK ASSESSMENT

3.01 Due to the steep nature of the site topography a certain amount of surface water will flow to the back of the building (the deepest basement) and round the flanks and not necessarily be retained by the 1.0m deep topsoil and action of vegetation. To minimise the effects of this a land drain is provided to collect this surface water. An external membrane is applied to the outside of the upper part of the basement above the clay to protect the basement from any standing water at this area.

3.02 Although the basement is founded in impermeable London Clay the contact between augered concrete piles and clay is not relied upon as being 100% effective as a water stop. Minor narrow partings of silt and sand should not be excluded and some water penetration may take place although at low permeability. An assessment of possible (worst case) water flow has been made by Dr Apollonia Gasparre of Geotechnical Consulting Group, see Appendix A and in order to minimise the hydrostatic pressures the sub-basement drainage is designed to carry this flow.

3.03 The water table is high because of the presence of the clay, however the basement is formed by piling and not by backfilling of an open excavation. The hydrostatic head between the perched water table at the top of the clay and the underside of the basement is therefore decreased by a) the low permeability of the clay, b) the low permeability of the cast in-situ concrete piles and clay, and c) the pressure relieving presence of the sub-basement drains.

3.04 The sensitivity of habitable rooms to damp/water penetration is high, Grade 3 and therefore no water penetration or damp areas is tolerable.

3.05 BS 8102:2009 Table 1 provides guidance on the use of different protection types based on water table classification, however there is no provision for loss of hydraulic head. For a perched water table the classification for this project is "high". For risk associated with the water table, due to augured piled wall – secant and infilled-contiguous – and underslab drainage, the category is "low". On this basis waterproofing Type B to a piled wall is acceptable.

3.06 It is not desirable to have the piled wall directly accessible therefore it will either be required to be combined with a fully bonded waterproofing barrier or faced with a concrete wall to BS EN 1992. The contiguous piles are to be faced with such concrete. Table 1 of BS 8102 does not differentiate between contiguous or secant piling, the risk values for passage of water/damp for each are quite different to such a degree that it is unjustifiable to consider them of equal value.

3.07 For a contiguous piled wall there is a very high risk of passage of water and an almost certainty of passage of damp. For a secant piled wall there is a very low risk of passage of water and a low risk of passage of damp. Exposure and facing of the contiguous piled wall with concrete brings the risk of passage of both water and damp to "very low" and "low" respectively. Exposure and reinstatement of continuity of concrete to the secant piled wall (e.g. due to piles being out of vertical tolerance) maintains the risk of passage of water at "very low" and passage of damp at "low". Therefore a well-cast a) secant wall and/or b) concrete faced contiguous wall result in a low risk to water/damp penetration to the basement.

3.08 In accordance with Table 1 BS 8102 measures to reduce risk should be considered and in particular reference is made to consideration of combined protection if a) the assessed risks are deemed to be high, b) the consequences of failure to achieve the required internal environment are too high or c) additional vapour checks are necessary for a system where unacceptable water vapour transmission may occur.

3.09 From the above points it can be seen that the assessed risks are not too high.

3.10 The consequences of failure of a Type B system to the habitable rooms would be high because damp would be unacceptable.

3.11 Failure of a Type B system would also cause water vapour transmission to occur.

3.12 Table 1 BS 8102 suggests the following measures to reduce risk:

a) Using combined protection.

b) Incorporation of maintained sub-surface drainage.

c) The use of a fully bonded waterproofing barrier.

d) Lowering the permeability of the main structural wall.

e) Using concrete with a waterproofing admixture.

f) Ensuring discharge systems remain effective.

3.13 Considering each of the above recommendations in turn:

Combined Protection: For a Type B wall Clause 6.2.2 BS 8102 mentions Type A and Type B or Type B and Type C.

a) The provision of a cavity and a blockwork face in front of the piled wall is of clear merit as these are separate systems. The cavity will keep any damp away from the blockwork surface. A drained cavity will keep any water away from the blockwork. A ventilated cavity will prevent the build up of water vapour pressure.

b) Sub-surface drainage is provided at high level and sub-basement drainage will drain the cavity to a pump chamber.

c) A fully bonded waterproofing barrier is too similar to a Type B system, i.e. they are both barriers.

d) Lowering the permeability of the main structural wall. The permeability of the wall is as low as reasonable for practicality and economy. Additional lowering would not change its principal function as a barrier system.

e) Sprayed concrete with a waterproofing admixture is already used in front of the contiguous piles.

f) The pumping chamber is to be located and alarmed such that it is easily maintained.

3.14 The use of Type A and Type B combined system results in two barriers. If a barrier system is considered at risk of failure from one cause then it raises the question as to why a second barrier should not fail from the same cause. A more effective back-up to one barrier would be based on a non-barrier system, such as a cavity as adopted.

3.15 It is therefore considered that a combined Type B and Type C system such as shown on drawing no. 8083/204/Rev. E reduces the risk to the habitable areas to an adequate degree.

3.16 Regarding non-habitable areas such as plant rooms where the consequences of damp penetration are of minor consequence and therefore acceptable, cavity protection need not be applied, however this is also being applied to keep in line with the overall construction.

4.00 CONCLUSIONS

4.01 The protection to habitable rooms will be adequately provided by the provision of:

a) Sub-surface and sub-basement drainage.

b1) Secant piling, made good and if necessary upon exposure or

b2) Contiguous piling with a wall of sprayed concrete with waterproofing admixture.

c) A drained and ventilated cavity face with a blockwork wall.

d) Service inspection openings within the blockwork cavity wall for long term maintenance.

4.02 The drainage below slab level is designed for 1.0m^3/month discharge based on GCG analysis.

For and on behalf of
TAYLOR WHALLEY SPYRA

JACEK GABRIELCZYK
BSc(Eng), CEng, MICE, MIStructE, MCIHT, MCIWEM, C.WEM

APPENDIX A

Assessment of possible (worst case) water flow by Geotechnical Consulting Group

GEOTECHNICAL CONSULTING GROUP
52A Cromwell Road, London, SW7 5BE, United Kingdom.
Tel: +44 (0)20 7581 8348 Email: admin@gcg.co.uk
Fax: +44 (0)20 7584 0157 Web: www.gcg.co.uk
Our ref: Your ref:

Uri Mizrahi,

Taylor Whalley Spyra,

3 Dufferin Avenue,

London EC1YBPQ.

13 May 2015

Dear Uri,

120 Finchley Road - GROUNDWATER SEEPAGE.

We have now carried out a seepage analysis using the program SEEPW in order to estimate the seepage rate across the site.

In the analysis we have modelled a section through the major axis of the site. We assumed the ground level at +65mOD on the north-eastern side of the site and +53.7mOD on the south-western side. The formation level of the basement is taken at +47.2mOD. The ground is assumed to be London Clay from the surface. We have assumed no flow through the wall above the base of the excavation.

The analysis assumed a permeability k of 5 x10^{-10} m/sec. This has been derived considering the lithology of the London Clay at the site and the available information on the permeability of London Clay (Hight et al. 2003). The horizontal permeability of the deepest lithological units of the London Clay has been measured to be between 10^{-10} and 10^{-9} m/sec, with the highest values for the sandier litholgocial unit (A2) and the lowest for the clayey unit (B2). The site is likely to be underlain by the upper lithological units of the London Clay Formation, which would be expected to be sandy in nature. Although data are not available, it is assumed that the horizontal permeability of these units would be relatively high. Considering also that the vertical permeability would be lower than the horizontal and that the flow into the excavation would depend both on horizontal and vertical permeability, a permeability of 5 x10^{-10} m/sec seems to be appropriate.

The results of the analysis show that the flow velocity into the base of the excavation varies between about 3.1 x 10^{-10} m/sec and 1 x 10^{-10} m/sec, with the highest values on the uphill side of the basement. Considering an average flow velocity of 2×10^{-10} m/sec and assuming that the basement is 20 m long, the total expected average flow is about 0.5 m^3/month.

Larger flow would be expected on the uphill side of the basement (around 0.8 m^3/month) and we would recommend that the drainage system is designed to cater for a larger flow. If observations show that the flow is greater than expected, any storage capacity is modified to adapt to it.

If you have any questions, please do not hesitate to get in touch.

Yours sincerely

For Geotechnical Consulting Group

Dr Apollonia Gasparre

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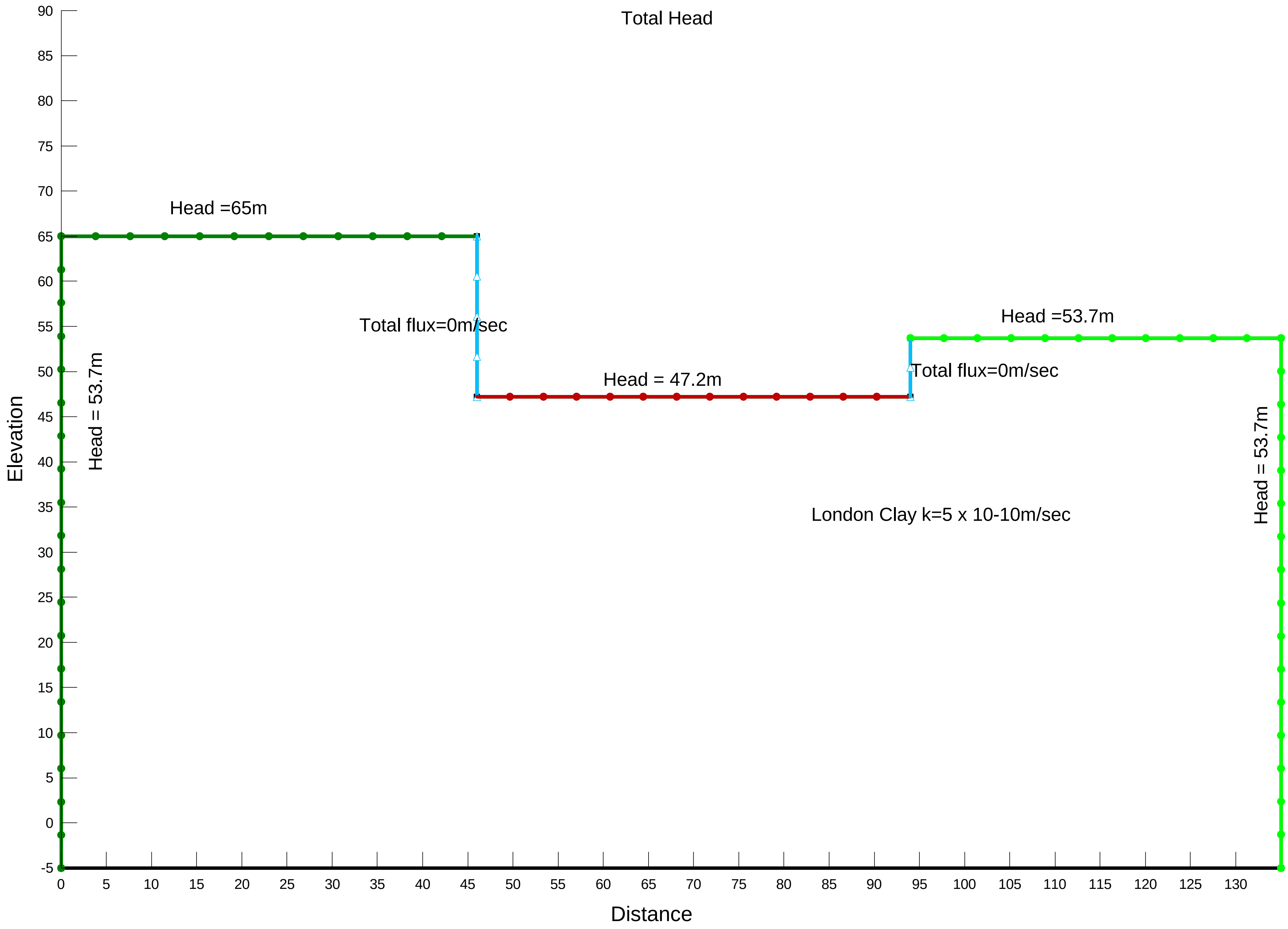

Total Head
Head =65m
Total flux=0m/sec
Head = 47.2m
Head =53.7m
Total flux=0m/sec
Head = 53.7m
Head = 53.7m
London Clay k=5 x 10-10m/sec
Elevation
Distance
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
-5
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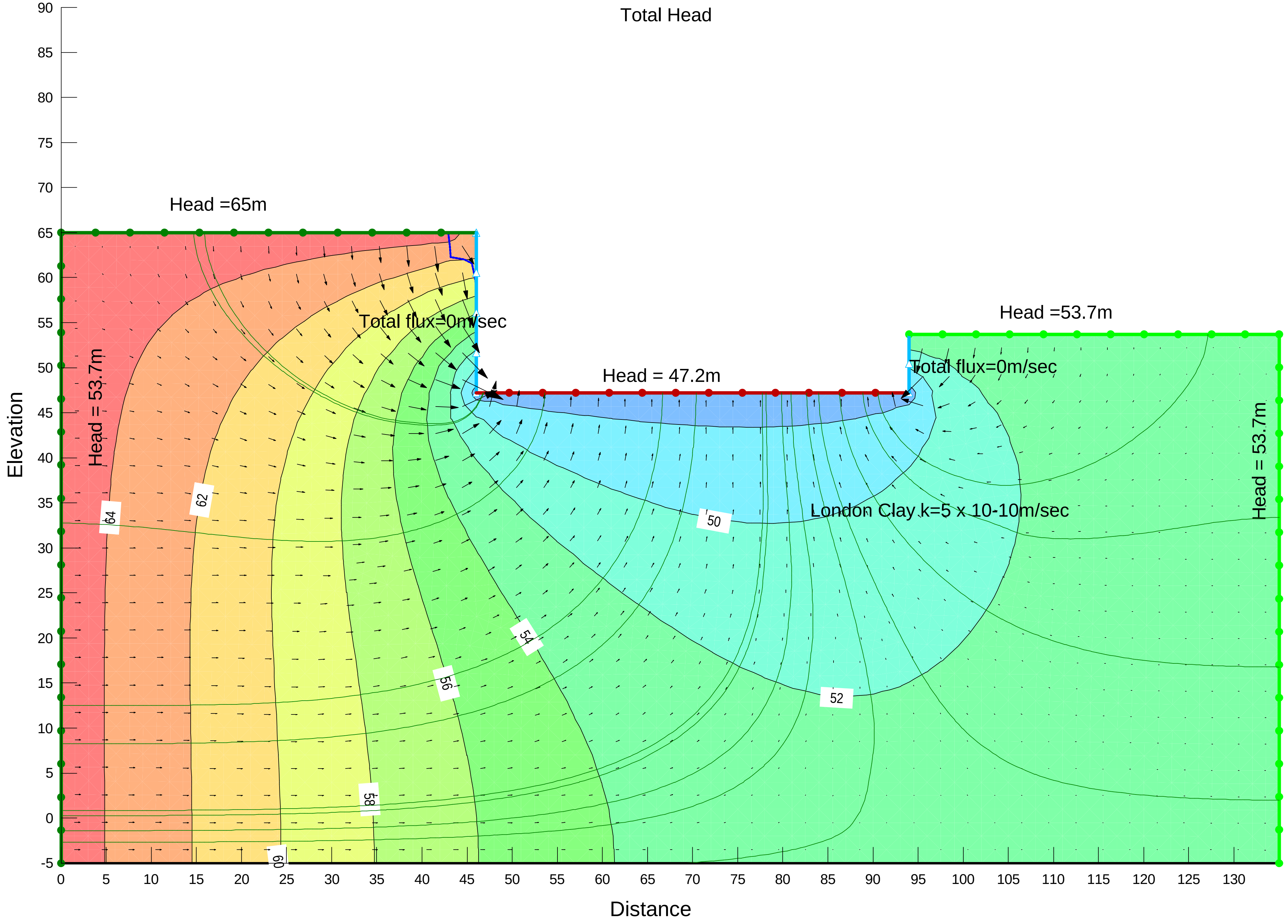
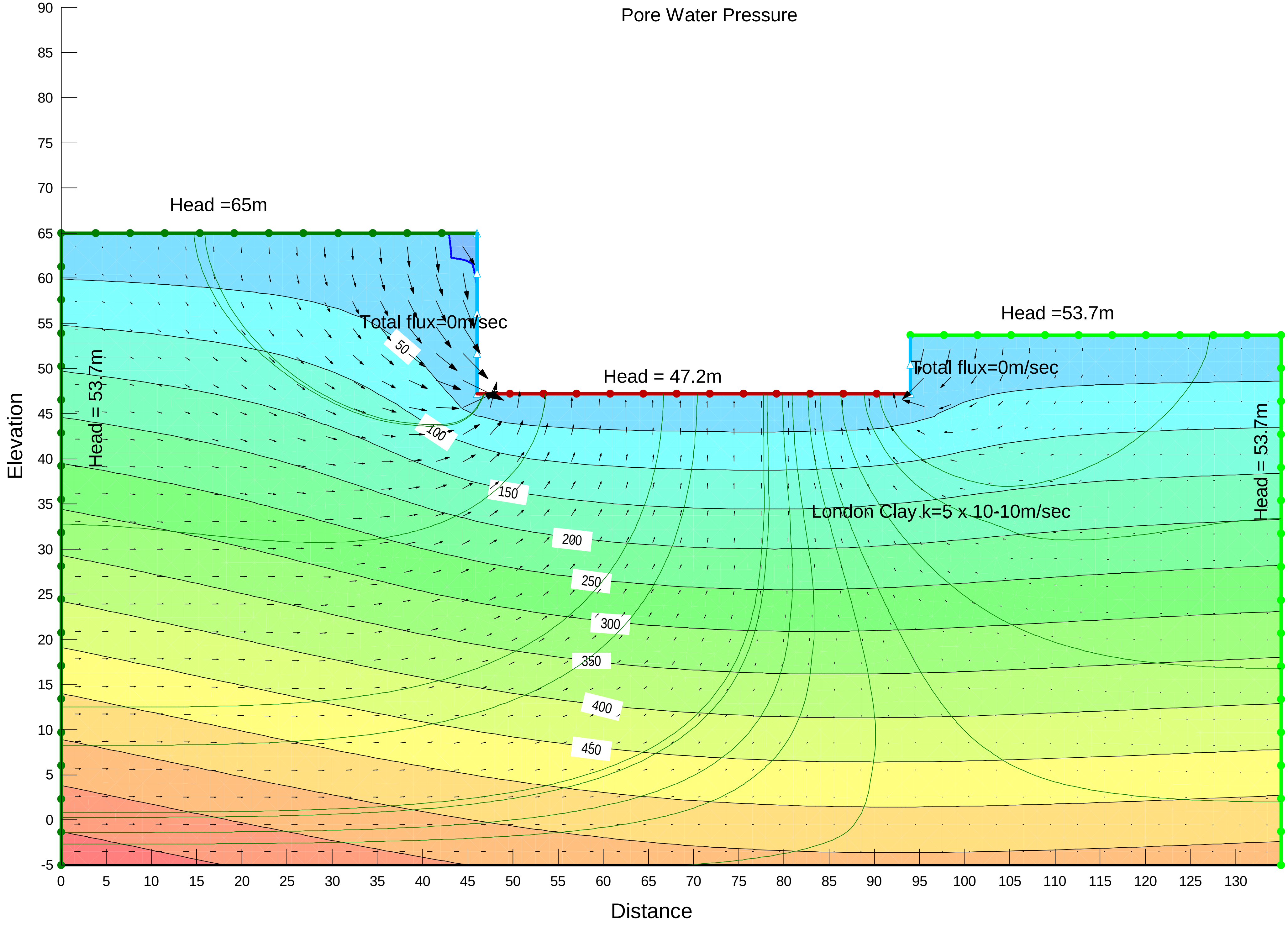


Total Head
Head =65m
Head =53.7m
Total flux=0m/sec
Head = 47.2m
Total flux=0m/sec
Head = 53.7m
Head = 53.7m
London Clay k=5 x 10-10m/sec
64
62
60
58
56
54
52
50
Elevation
Distance



Pore Water Pressure
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Total flux=0m/sec
Head = 47.2m
Head =53.7m
Total flux=0m/sec
Head = 53.7m
Head = 53.7m
London Clay k=5 x 10-10m/sec
50
100
150
200
250
300
350
400
450
Elevation
Distance
90
85
80
75
70
65
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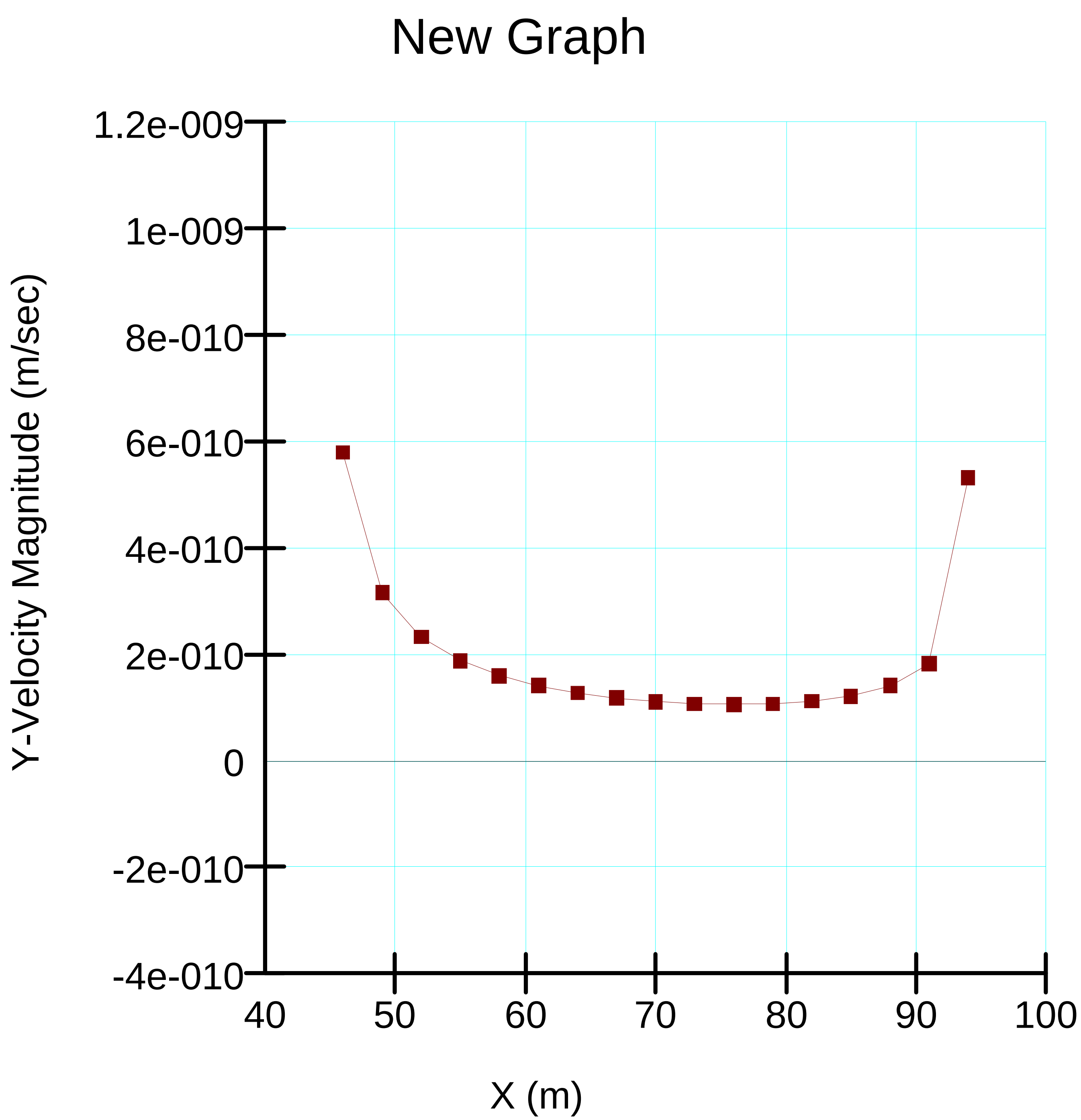
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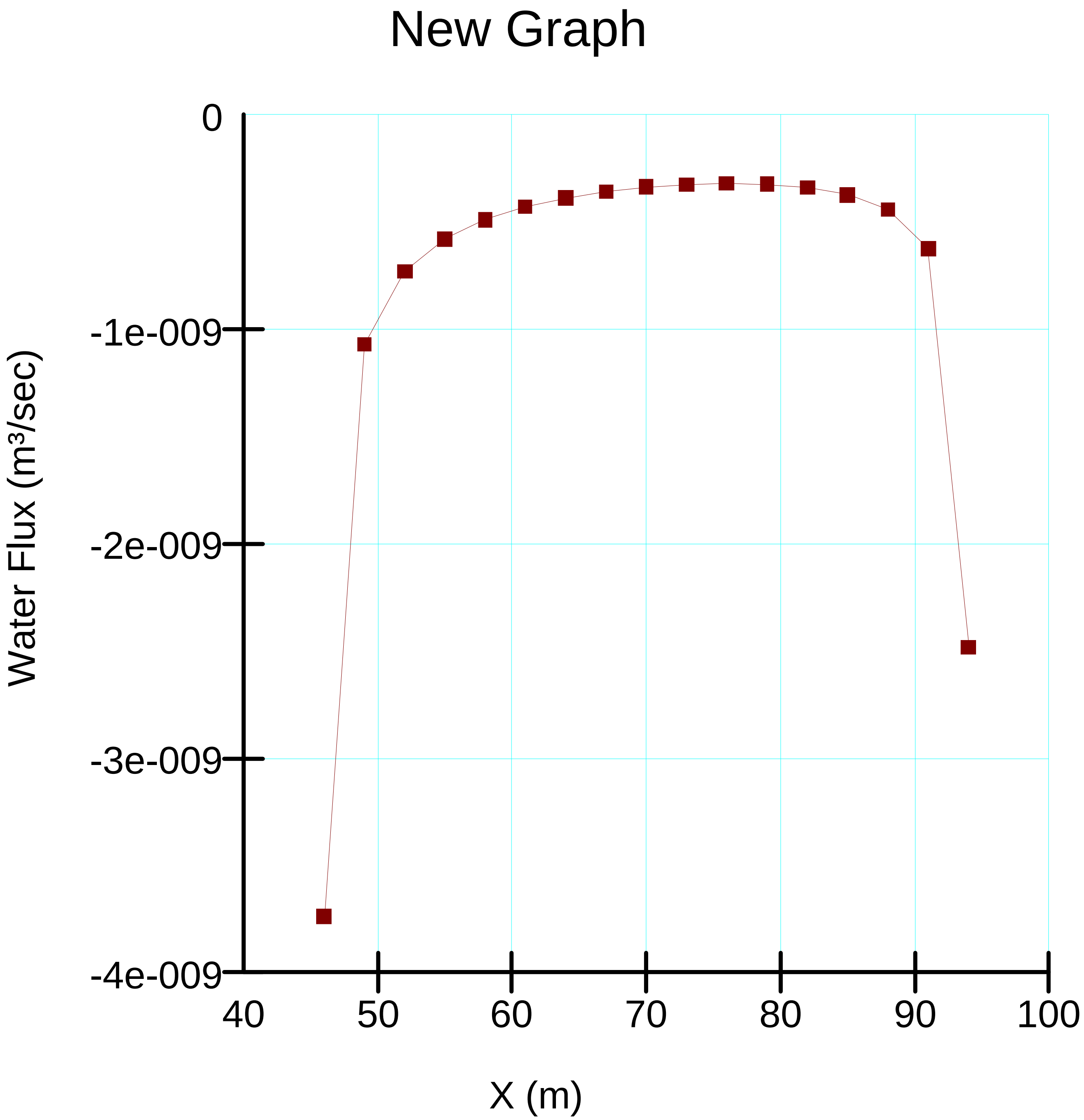
1e-009
8e-010
6e-010
4e-010
2e-010
0
-2e-010
-4e-010
40
50
60
70
80
90
100
Y-Velocity Magnitude (m/sec)
X (m)


New Graph
0
-1e-009
-2e-009
-3e-009
-4e-009
Water Flux (m³/sec)
40
50
60
70
80
90
100
X (m)