99A Frognal, NW3 6XR

Structural Strategy Report for Planning Submission

Ref. No.: **22719**

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FLUID.STRUCTURES ENGINEERS AND TECHNICAL DESIGNERS

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This report has been prepared for the benefit of our client, Harrison Varma Limited, and the relevant Planning Authorities. No liability shall pass to any third party that chooses to makes use of this report for any purpose whatsoever.

This report should be read in conjunction with the Architect's Planning drawings.

1 INTRODUCTION

1.1 Background

Fluid Structures is the Structural Engineer for the construction of a new private house with single storey basement at 99A Frognal, Hampstead. The proposed new building will occupy the site of an existing house, which is to be demolished as part of the proposed works.

1.2 Purpose

This report has been prepared for the benefit of the Planning Authorities in order to demonstrate that Fluid has identified strategies for the new superstructure and substructure that are:

- Structurally adequate;
- Appropriate to the site and ground conditions;
- Buildable;
- Complementary to the architectural and aesthetic principles of the scheme.

The report is also intended to show that Fluid has the necessary technical expertise and prior experience to be able to execute the proposed structural strategies to an acceptably high standard.

1.3 Executive Summary

This report looks first at Fluid Structures, with a view to highlighting the practice's experience in the fields of basement design and residential construction. The site and ground conditions are discussed, with an emphasis on assessing their impact on the proposed structural scheme. The intended strategies for the substructure and superstructure design are presented in broad terms. The substructure strategy is focused in particular on minimising disruption to nearby existing structures and their existing loadpaths.

2 ABOUT FLUID STRUCTURES

Fluid Structures is one of the UK's leading design oriented structural engineering practices. The firm was established in 1999 and has gained an exemplary reputation for the quality of its engineering design. Fluid has been commissioned to work at the Science Museum (twice), and the Royal Festival Hall, and has acted as a consultant to the BBC. The sectors in which the company works regularly include education, retail, residential and commercial. Projects to date have ranged in value from £500,000 to in excess of £100 million.

Fluid's approach is characterised by a desire to develop an engineering solution that complements the architectural aspiration whilst also responding to the client's core requirements and maintaining a sensitivity to the priorities of other stakeholders, such as the Planning Authorities; Conservation Officers; and the building's future occupants.

The practice considers itself to be a technical design house and offers a number of areas of expertise that include:

- The design of complex basements and substructures
- Developing bespoke structural solutions that respond to difficult site constraints
- An in depth knowledge of construction materials including steel, concrete, timber, masonry, glass, aluminium and fabric
- Sustainable design solutions: working within the constraints of individual projects to minimise the carbon footprint of buildings and maximise their positive impact in relation to the environment, the economy and society at large

Some previous residential project examples are illustrated overleaf. These demonstrate Fluid's ability to deliver intelligent and efficient engineering solutions.

El Ray, Dungeness

Project cost £200,000; Architect: Simon Conder Associates

The beach house comprised a timber superstructure supported on a ground-bearing reinforced concrete raft. The timber roof and walls comprised plywood decking and sheathing fixed to STEICO timber I joists and I studs. The glazed elevation facing the beach was formed with two, parallel, 8m span KERTO timber portal frames to allow the sliding/folding glazed doors to open full width. The external wall and roof surfaces were clad with Itaube planks

Huttons Farm

Project cost £18.0 million; Architect: Giles Quarme and Associates

Huttons Farm is a traditional Chilterns Farm complex consisting of a number of early Nineteenth Century timber barns surrounding a brick and flint farmhouse. It is located in an Area of Outstanding Natural Beauty. The development includes an underground art gallery and a domed timber gridshell roof.

Castelnau Pool

Project cost £4 million; Architect: Brybuild Ltd

The work involved the refurbishment of an existing detached property in South West London. A new extension and basement were added to provide swimming pool leisure facilities. The shell of the pool enclosure and basement were formed using reinforced water-proof concrete. The pool has a glass end wall designed to cater for the water pressure and the dynamic loadings exerted by swimmer kicking off the wall.

3 SITE AND GROUND CONDITIONS

This section should be read in conjunction with **Geotechnical and Environmental Associates; Desk Study Report: 99A Frognal, London, NW3; May 2010**. It is the intention that an intrusive Ground Investigation will be carried out at a later date to determine more detailed geotechnical parameters.

3.1 Site Conditions

The topography of the site is very variable, with substantial level changes both within the confines of the site and between the site and adjacent plots of land. There are Party walls (mostly garden walls) to all perimeters of the site, and these frequently act as retaining walls to allow for the level changes described.

The existing house occupies a prominent position on the site. This house will be demolished as part of the contract works. Demolition will need to be carried out with an emphasis on minimising the noise and disruption experienced by neighbouring residents. The demolition process should be conducted as a reversal of the original construction process, with health and safety considered foremost.

Site access for the demolition and construction works will be via the main drive up to the house, which offers reasonable width for construction traffic. There will be little scope to park construction vehicles outside of the site, since there are restrictions on parking on the adjacent road.

3.2 Geotechnical Conditions

A desktop analysis of the site reveals that the underlying soils are Bagshot Beds, and that these in turn overlie London Clay. The Bagshot Beds comprise sands with variable clay content. This stratum is likely to extend to at least 5m depth, but possibly to considerably more than this. The Bagshot Beds will be capable of sustaining light to moderate loads on shallow pad or strip footings. The extent of Made Ground overlying the natural ground could be considerate and this will need to be checked via the Ground Investigation.

Groundwater levels are not known at this stage, but the variable topography of the site introduces the risk of rainwater run-off from higher areas to lower ground. Even if the equilibrium groundwater level is below the basement level (likely), perched water may be encountered in the Made Ground. The Contractor may therefore need to allow for groundwater pumping during the process of excavating the ground. The basement will need to be designed taking into account the buoyancy load arising from the worst case ground water level, for example in the event of a future storm or burst water main.

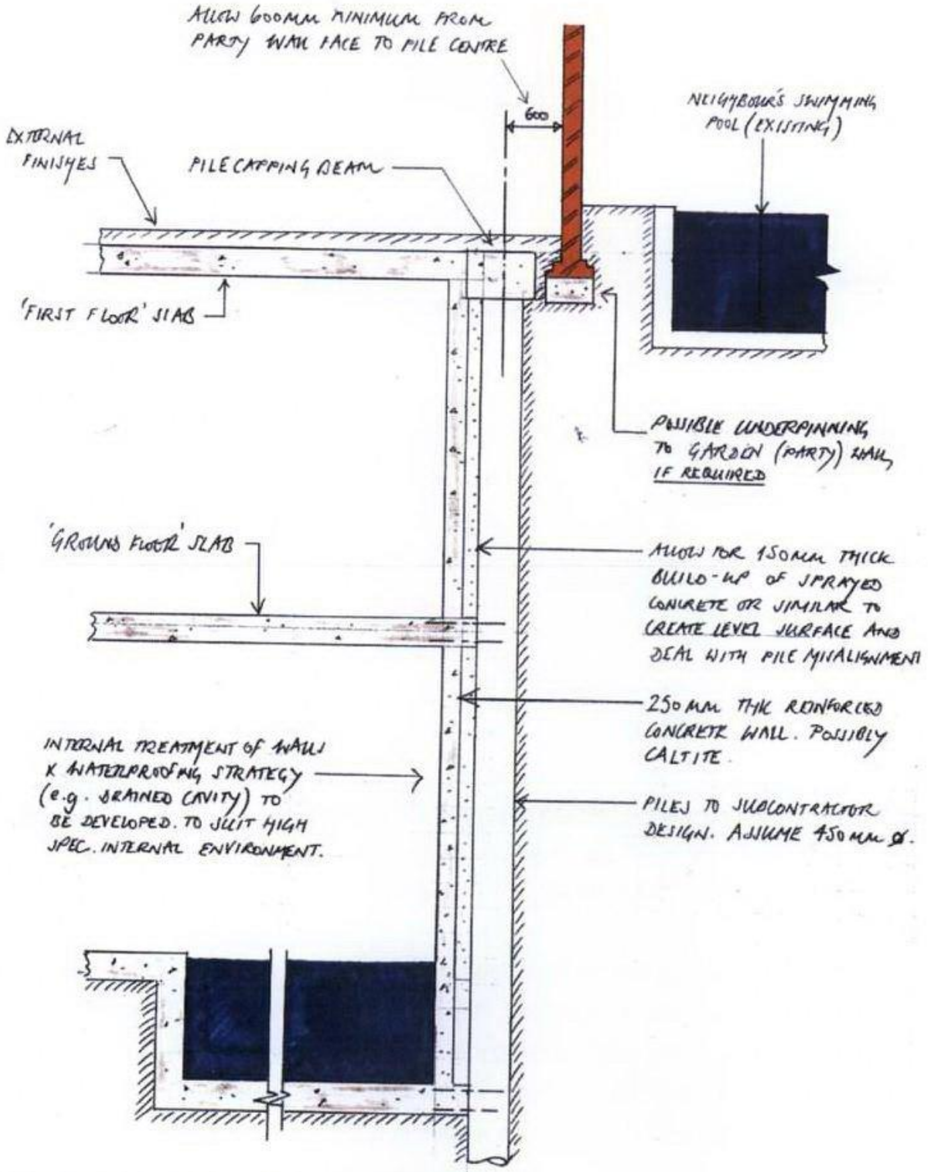
3.3 Geoenvironmental Scenario

Environmental searches for the site do not indicate that the site has had a potentially contaminative history and as such, the risk of contamination on the site has been assessed as very low.

Photos showing variation in ground levels within the existing site

4 SUBSTRUCTURE STRATEGY

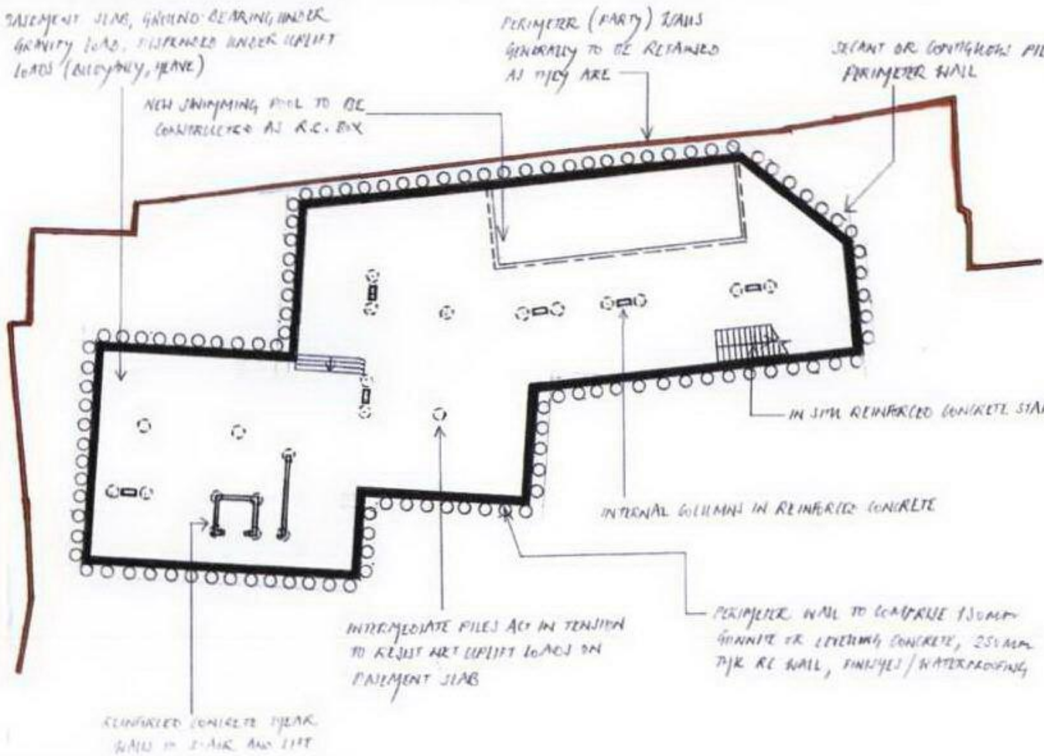
Critically, the construction of the proposed new basement must minimise impact on the existing site perimeter walls. It is recommended therefore that, in order to construct the basement, a perimeter wall should first be constructed around the basement footprint comprising secant or contiguous piles (depending on the cohesiveness of the soil and ground water levels). This wall will act as a perimeter retaining structure, enabling the soil within it to be excavated to the full depth of the basement, without impacting on adjacent, existing structures. The piles will be restrained at their head by a perimeter pile capping beam. If it is impossible to avoid undermining some existing perimeter wall footings in the process of excavating for the capping beam, underpinning to the existing walls could be considered as a last resort (but in the main, it is hoped that this will be avoided).



Typical section on perimeter wall to proposed basement

Once the ground within the perimeter piled wall has been fully excavated, the basement can be constructed as an in situ concrete box.

The basement ground slab will in all probability be designed as ground-bearing when subject to gravity loads, but it will behave as a suspended slab under uplift loading which would result either from high groundwater (buoyancy) or clay heave. In this instance, the slab will transfer its load between the perimeter piled wall and some intermediate piles below the basement slab (positioned to limit the clear slab spans). Carrying uplift loads as tensions in the piled foundations is likely to be more efficient than trying to resist this uplift purely by increasing the self-weight of the basement structure.



Approximate plan on basement slab structure

Internal columns and load-bearing walls within the basement - and the ground floor slab - will be formed in in situ concrete. The basement 'box' can therefore be constructed entirely by a single concrete subcontractor, providing a safe platform for the erection of the superstructure above.

The basement waterproofing strategy will be developed in accordance with the architect, taking into account the requirement to provide a high-spec, dry, internal environment. A combination of waterproofing methods is likely to be used, drawing on (i) drained cavity construction, (ii) external tanking, and (iii) waterproof concrete / Caltite. The waterproofing of the swimming pool will be given particular consideration, given the need to keep the pool water in and ground water out.

5 SUPERSTRUCTURE STRATEGY

The superstructure scheme for the proposed house will be developed to best suit the architectural and aesthetic aspirations for the building. Although the use of conventional forms of low-rise construction, such as load-bearing masonry and timber joists, will be considered, it is anticipated that a steel frame solution may offer a more efficient approach. This will provide greater freedom to create large-scale window openings, and double-height and split level spaces.

Emphasis will be placed on developing a sustainable superstructure scheme. The benefits of using low-embodied energy materials, such as sustainably sourced timber, will be compared carefully with the advantage of harnessing the high thermal mass of higher embodied energy materials such as concrete. Consideration will be given to detailing the structure to minimise thermal bridging and maximise the energy efficiency of the building in use.

The palette of structural materials will also be selected on grounds of construction speed and ease of erection, given the restrictions on access to the site and the need to minimise noise and disruption during the works.

6 CONCLUSIONS

This report has sought to demonstrate Fluid's competence and past experience in designing basements and innovative residential structures. It is Fluid's intention to apply its technical knowledge to deliver efficient and elegant structural solutions for the proposed new-build house at 99A Frognal.

The ground conditions at the site have been discussed. It is noted that a considerable challenge to the construction process will be the variable site levels and the range of existing boundary conditions.

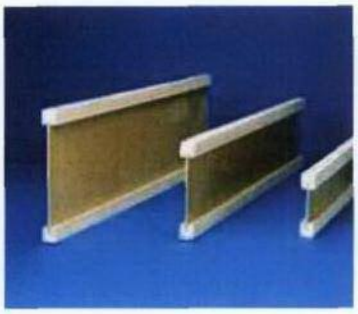
It is proposed that the basement structure should be constructed by forming a perimeter piled wall, within which the ground can be excavated with minimal impact on the surrounding perimeter structures. The basement can then be constructed, bottom-up, as a simple in situ reinforced concrete box.

The superstructure design for the proposed new house will be developed with architectural aspiration and sustainability considered foremost.

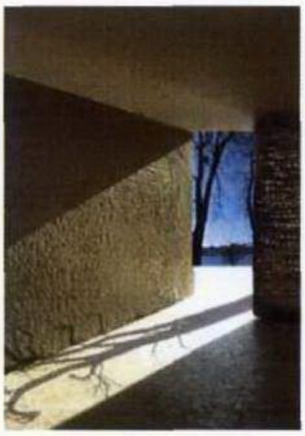
7 SUSTAINABILITY STATEMENT

Long Life, Loose Fit, Low Energy

The building industry in the 21st century is at last showing signs of a widespread and meaningful move away from the energy-profligate building construction of the last 100 years. In the UK the energy consumed in buildings represents almost half of all the energy used in the country, so there is massive scope for improvements. As energy prices rise, and regulatory building standards are tightened, there is ever more incentive to achieve higher standards of construction.



There are now many aids to more sustainable building design available in the market place, ranging from "new" construction materials with reduced environmental footprints, through heat recovery ventilation systems of all scales, to various renewable technologies to provide low carbon energy. These can all play a part, in the right circumstances, to reducing the environmental impact of building construction, refurbishment and occupation.



Fluid believes however that the real key to successful building design and construction remains not in "bolt-ons", and similar quick fixes, but in considered and open minded holistic design. In almost every case a low energy, economical and rewarding building will only be realised when the structural engineer engages fully with the architect, client, and building physicist to understand the use of a building, its operational requirements and limitations, and works to the right form of construction for a given site. Maximising passive performance is usually key. In some cases the ideal solution may be a building of lightweight construction, perhaps with enhanced ventilation and solar shading, whilst in others the appropriate solution will be a more massive construction perhaps with exposed masonry, concrete or even earth elements to attenuate temperature fluctuations. Whatever the merits of each case Fluid Structures will work to seek out opportunities for producing buildings which can be built in the real world by real people and perform as the architect intended.