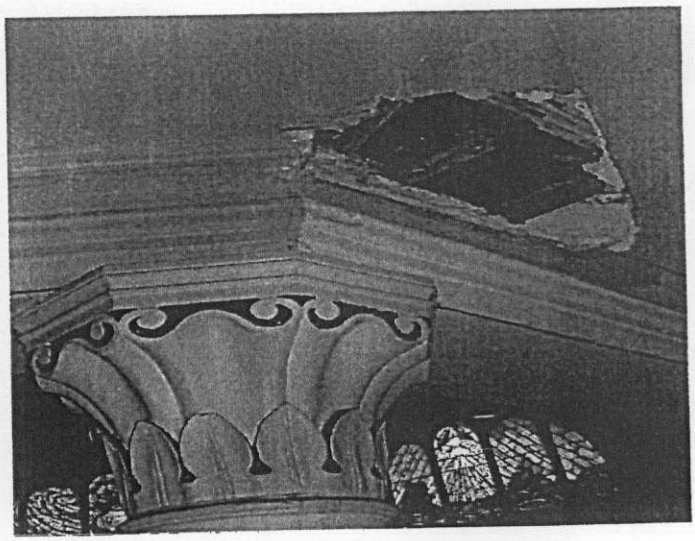
STRUCTURAL ENGINEERS REPORT

on

HAMPSTEAD SYNAGOGUE

in conjunction with

STEPHEN LEVRANT HERITAGE ARCHITECTURE



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HAMPSTEAD SYNAGOGUE

I N D E X

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1.0 INTRODUCTION AND BRIEF

We were asked by United Synagogue on behalf of the Hampstead Synagogue to inspect the building and to prepare a Structural Engineer's report on its condition. This is part of the preparation work for a scheme of repair and overhaul for the whole building.

1.1 The repairs will be carried out in conjunction with improvements to non-structural elements, review, overhaul and/or replacement of all the built surfaces.

1.2 The building is in use, and furnished as a synagogue throughout, so access is limited in places, and arrangements were made to carry out selective opening up by builders D.W. Bevan.

1.3 A preliminary inspection was carried out in June, 2005, a first detailed inspection on Thursday 23rd February, 2006, a second inspection on Monday 6th March, 2006, and a third inspection on 23rd March, 2006. D.W. Bevan were in attendance on 23rd February, 2006 and opened up the plasterworks in locations TP1 to TP6 and on 23rd March, 2006 when they opened up floors at TP7 to TP10 as annotated on the key plans attached. (See Appendix B). They also erected a scaffold to give access to the underside of the dome.

1.4 Bevans also provided lighting and assisted with access on to the roofs.

1.5 With a large complex building such as this it is not possible to inspect and record all the possible information on one visit. Collection of such information prior to tender is a continuous process and will continue after completion and distribution of this report.

1.6 While the purpose of this report is to deal primarily with the structural elements and structural stability of the building, this has continuous interaction with finishes and built fabric, such as wall plaster, plaster casings, roof coverings, floorboarding, gutter boarding copings stones and the like.

1.7 Such elements are commented on in passing only and recorded in the site inspection notes which are included at Appendix A. Specialist advice may be needed, for example on the extensive and important stained glass windows.

1.8 A series of photographs were taken throughout the inspections and these are included at Appendix C, in three sections, one from each visit. Some photographs repeat views of the same element, but in different light and weather conditions and from different viewpoints.

1.9 The weather on 23rd February, 2006 was poor, varying from snow to intermittent rain. The weather on 23rd March, 2006 was bright and dry.

1.10 Inspection of the interior is limited by the finishes, and access to high level and on the roof, in particular, is limited to what safely may be viewed in some cases from adjacent vantage points.

1.11 No assurance is given that areas that are covered or are inaccessible are free from rot, decay, cracks or other damage.

1.12 The basis of this report is a visual inspection by a qualified Structural Engineer with 30 years experience of buildings of all types and conditions, supplemented by the opening up and physical investigation which can be readily carried out by the attending builders to date.

1.13 Directions are given as given as the liturgical compass point on the key plan. The elevation to Dennington Park Road is west, the elevation facing the back of West End Lane north, the end elevation facing at the back of Sandwell Crescent, east. The elevation facing the adjoining synagogue meeting room, is south.

2.0 BUILDING AND STRUCTURE

2.1 The general description of the building and its fittings and history is well known and fully documented by the Architect and is not reproduced here.

2.2 The building has been extended (see history), the form of construction appears to be similar, and for the purpose of this investigation and report the synagogue is treated as one building and more or less as one build.

2.3 External walls are solid brickwork and mostly soft red facing brick, but in certain locations, assumed to be where they are considered away from the public view; common fletton brickwork is used.

2.4 As far as can be ascertained the brickwork is bonded solid through, but there is not enough plaster stripped in any particular place to give a full appreciation as to what mixture of bricks was used for internal parts of walls.

2.5 The brickwork thickness varies and in particular in the tower walls is up to 650mm, about three whole bricks thick.

2.6 The internal structure carrying the high level walls, semi-circular clerestory windows the gallery over the main auditorium is supported on a series of eight circular columns.

2.7 These columns are cast iron, about 300mm diameter. They support the inner face of the gallery structure at about mid height and below this level they are encased in marble (or similar) and above are painted. Decorative elements, leafwork and mouldings which embellish the columns are plasterwork additions.

2.8 At the level of the gallery the columns have flanges or brackets cast on which carry "I" section steel beams, 250mm x 125mm spanning between the cast iron columns to support the timber framed gallery structure.

2.9 At high level the tops of the columns have pairs of "I" section mild steel beams spanning between, and seated on the tops of the columns which then carry the brickwork to the high level walls and clerestory windows above.

2.10 It may be that there are other steel beams providing lateral restraint or support to columns within the structure of the gallery floors, but these were not open to inspection.

2.11 In addition to the eight columns around the perimeter of the gallery there are four freestanding columns which rise full height from the floor to the underside of the high level walls.

2.12 Above the auditorium a dome rises to a stained glass light and ventilation louvre. this dome is ribbed in decorative plasterwork on, as far as can be deduced, a structural steel frame.

2.13 Around the entrance areas the first floor toilets and the like there are flat roofs mostly timber construction, covered in boarding and mineral felt.

2.14 Over the main body of the auditorium and the aisles and gallery, the roofs are pitched, natural slating on square edge boarding on rafters falling to internal and external perimeter gutters.

2.15 There is some limited and not particularly safe access to these roofs.

2.16 By the entrance on the west elevation there is a substantial brick tower with a steep side pitched roof framed in timber and slated and boarded as before, set behind perimeter parapets and corner turrets.

2.17 The flat roofs are covered in mineral felt. The roofs to the tower are natural slating fully exposed and all the other roofs are natural slating which have been covered in bitumen.

2.18 The age of the roof covering is not known, but it may be that apart from the mineral roofing felt, all the pitched roofs have the original slates.

2.19 To the east end there are small areas of flat roof with octagonal rooflights. These flat areas are covered in leadwork, again heavily coated with bitumen.

2.20 The main body of the auditorium G9 is almost completely timber framed floors seated on dwarf walls such as might be found in the ground floor of a house of the same period.

2.21 The entrance area is mosaic on concrete, but the construction is not known beyond this. The concrete may be laid on the fill material, or cast around steel beams spanning between perimeter walls.

2.22 The foundations are not known, but see later.

2.23 The layout of the building is based on the key plans attached and the room numbers on those key plans. This gives a fair guide for this initial assessment and report, but a full measured survey is being prepared which will enable a more detailed assessment and particularly assist with estimating of repairs and costings, and relative levels of various elements.

3.0 THE SITE

3.1 The site follows the slope of Dennington Park Road from upper left when viewing the building to the right, that is it falls from north to south, and also falls from west to east. The arrangement of the building makes the changes in level difficult to assess, but these will simply be explicit on the measured survey when available.

3.2 There are no trees or vegetation on the site or nearby likely to be relevant to the foundations and soil conditions.

3.3 The drainage layout is not known, but it is being investigated, and this will be checked when it is made explicit to see if there is any relevance to structural aspects.

3.4 The precise soil conditions are not known but will be investigated if that becomes relevant.

3.5 Typically in the area the soil is weathered brown clay overlying grey blue London clay.

3.6 Such clay is known for its shrinkable properties particularly due to loss of moisture content at superficial levels in the prolonged dry weather, or when there is moisture extraction by tree roots.

3.7 Clay shrinkage can have serious, even catastrophic, effects on Victorian housing which have shallow foundations, particularly where there are changes in level between basement and non-basement areas and around poorly built elements such as bay windows, but the synagogue is substantially built, and much heavier and was purpose designed by a respected Architect; so it is not particularly sensitive to these soil conditions.

3.8 Such clay sub-soils also exhibit compression over a long period of time, and it is common for large buildings to exhibit slight differential movement between heavier and lighter elements, for example between a tower or spire and single storey extensions.

4.0 HISTORY

4.1 The summary history given in the extract from "List of Buildings of Architectural and Historic Interest" is attached.

4.2 The historic development of the building on the key plans is interesting, but not completely explicit.

4.3 The steel beam sizes measured in the opened up plaster casings, i.e. 250mm x 125mm (10" x 5") (and 200mm x 100mm (8" x 4") are readily identified in the schedule of beam sizes rolled by Dorman Long & Co in 1887.

5.0 EARLY ACTIONS

5.1 The main sweep of this report is to deal with the structural condition of the building as part of background to necessary repairs, overhaul, alterations and to aid the Architect in preparing specification, the Quantity Surveyor preparing costings and the Services Engineer to understand the possible routes for services throughout the building. This is on a long-term view, but there are certain actions which would benefit the building are necessary in the very short term and should be considered under a separate arrangement.

5.2 These actions are not necessarily of a structural nature and should be considered by others members of the design team and client body.

5.3 The tower roof is the highest part of the building and indeed the highest building in the vicinity. It has some form of lighting protection, but the conductor strips seem to be loose and drape over the parapets, which is unusual. The lightning conductors ought to be checked and verified and if necessary fixed in place by a specialist firm.

5.4 The gutters and outlets to the roofs particularly the flat roofs ought to be swept cleaned out, all debris removed so that all rainwater freely escapes according to the present layout of the building.

5.5 The parapet on the east face of the tower, the part which overhangs above roof R2 is extremely loose and distorted. A shrub has rooted in the brickwork and daylight may be seen between the bricks. This parapet, unlike the parapets to the other three sides of the to tower does not have copings stones. Depending on the programme, consideration ought to be given to taking down this parapet or rebuilding it or adding some further protection to it. (Photographs may be seen P104 and P346 and P349 attached). At very least the shrub should be poisoned to prevent further growth from causing even more damage.

5.6 The roofs over the fire escape route to West End Lane are extremely decayed and could be considered a hazard if an emergency evacuation was required. These roofs may be seen at photographs P0075 and P0076. It may be that, in the interests of safety, these roofs simply be taken down, the broken glass and decayed boarding removed until replaced with some permanent arrangement in the scheme of works.

5.7 The "sushi" shop in West End Lane parks a motorcycle in front of the fire escape door. This could be a hazard in case of emergency evacuation. See P347. The owners should be advised, and asked to park elsewhere.

5.8 Although the front doors are kept secure the fire escape doors to the passage along he north side seem to be unlocked. See P318. This is vulnerable to unauthorised entry from over the back of the shops in West End Lane.

5.9 It is likely that the roofing works will require scaffolding erected in the passageways along the north and south side of the building. Along the north side there are intrusions into this passageway from boiler flues in the backs of the shops and accommodation in West End Lane. It is not known if these have been given approval by the Synagogue authorities, but they may be considered a trespass. It may be appropriate to start some investigation or enquiry about these at the present time, so that they are not a hindrance to the work in due course. These may be seen in photographs P0071 and P0074.

5.10 Demolition work is taking place to the building previously owned by the Synagogue adjacent the southeast corner in Kingdon Street. Presumably formal arrangements have been made about this and the raw edges of the brickwork to the Synagogue etc., would be made good by the Building Contractors when the current demolition works are complete.

5.11 There seems to be a continuous water overflow outside G6, see P317. The offending water tank etc., should be repaired.

5.12 The concrete cill to the north window on the east face of the tower has broken up, the pieces ought to be removed for safety. See P344.

6.0.0 REPAIRS AND RECOMMENDATIONS

6.1.0 Internal Framing

6.1.1 The internal framing support systems are as explained in the site notes, a series of typically 300mm diameter cast iron columns rising full height from the floor to support the high level walls. The walls and face of the balconies are carried on modern style mild steel "I" sections comfortably seated on flanges cast into the columns. All this framing system seems sound, and there is no obvious basis for concern or apparent need for further investigation.

6.1.2 The gallery is supported on this system and while there is no facility to calculate precisely to assess the strength of the gallery, there is no evidence of misuse or distress or any need for specific further detailed investigation in this area.

6.1.3 Although there have been roof leaks above at the area opened up, the gallery floor and framing appear sound, though the boarding has suffered surface decay.

6.1.4 There is, however, one matter in that the floor void seems to contain a lot of shavings and debris, which would appear to be original. (It would seem that the careless procedure sweeping debris under the floorboards is not a new habit). If boarding is to be lifted or plasterwork taken down all this should be cleared out since it is a fire hazard and increases the flammable material within the building.

6.1.5 The floor of the auditorium (G9) is softwood boarding on joists. This mostly seems sound, but all along the north wall the joint ends and bearer timbers are decayed and must be replaced.

6.2.0 **The Roofs**

6.2.1 The roof structure was opened up from the underside at three locations. At all these locations the roof framing and main structural timbers were found to be sound. Around the perimeter of the high level walling and clerestory windows, the wall was seated on pairs of steel beams which again are sound.

6.2.2 There was no specific evidence of decayed timber, but it is known that there are leaks through the roof particularly from the valley gutters, and there has certainly been considerable leakage in the past, it must be assumed at least areas of the gutter boarding will be decayed and generous allowances should be made for replacement.

6.2.3 More modest allowances should be made for replacement of decayed rafter ends around the perimeter gutters.

6.2.4 Although it needs to be dealt with by the Architect it is clear that the slating to all the pitched roofs at low level, that is R2, R6, R6, R3, R4, R11, R12, R9 etc., needs to be replaced.

6.2.5 This work is more complex then simply stripping and replacing the slating.

6.2.6 There is a need for safe access along the internal gutters so that they can they can be cleaned out in the future, readily and safely and properly maintained. In the past the gutters adjacent to the brickwork are so narrow that people walking these have broken and damaged the slate even to such an extent that the boarding is visible. This re-arrangement is likely to be awkward and expensive.

6.2.7 The roof over the main high level octagonal roof should be provided with clear and safe access with proprietary restraint systems etc.,

6.2.8 The present arrangement of, for example, the steel cat ladder from R5 to R13 although just about passable should be renewed in other materials in a manner to allow safe access.

6.2.9 The low level roofs over the toilets at G8 and G5 should simply have allowance for complete renewal, framing, boarding, ceiling and covering.

6.2.10 The roofs over the escape route at F8 to West End lane referred to in section 5 above need removal, and it is assumed replacement, although this may be open to discussion.

6.2.11 The details of the work to the roof should allow for a generous ventilation built in to permit both the existing timbers to dry out and for timbers to be ventilated in the future long term.

6.2.12 The octagonal rooflights have not been examined in detail, but it was noted that there are different sorts of glass and it may be that on specialist advice they need to be re-glazed with an appropriate form of safety glass.

6.3.0 **External Walls**

6.3.1 The condition of the bricks in the walls would seem remarkably good condition throughout the building.

6.3.2 There are large areas that will need repointing particularly the exposed areas on the north elevation at high level.

6.3.3 Parapets around the tower at the west end that is around the roof R1 are of particular concern. Mention has been made in section 5 above that the parapet on the east face of R1 no longer has its copings stones and which is distressed, and probably ought to be taken down forthwith. It certainly needs rebuilding.

6.3.4 The other adjacent parapets to the north; south and west requires some overhaul. It is for discussion as to whether the copings in these ought to be reset.

6.3.5 There appears to be stonework stored within the attic room below R1 whether these are coping stones previous removed from the east parapet is not clear. The stones are covered in guano, they ought to be cleaned off and assessed for possible re-use. If they are not relevant they should be removed from site, or at least from storage within the roof tower.

6.3.6 The parapets to the lower level roofs R14 and R15 are in mediocre condition. The copings should be re-set at least along part of their length see particularly photographs P0116, P0121 for roof R15 and P0039, P0042 for roof R14.

6.3.7 The design of the tower is such that the walls step in at high level around the parapet as may be seen in photograph P0117. This sloping area is not safely accessed either from above or below, but is clearly vulnerable to the weather and will need at least full and careful repointing and due allowance for replacement bricks. See also P326 to P329.

6.3.8 On the east face of the tower, the concrete cill and lintel to the north window have broken up and need to be replaced. (See P344 and P345).

6.3.9 It is clear from the interior that there is considerable areas of decayed plaster and that walls have become saturated from water ingress in the past. It is a characteristic of buildings typically from about 1700 to 1900, that they often contain "bonding" timbers built into the brickwork in the middle of the wall or on the inner face. Where there was water ingress such as here the timbers are invariably decayed, required to be cut out, the voids filled with brickwork or concrete. Such decayed timbers are often found as a surprise and add cost to the works involved in replastering.

6.3.10 As far as we can tell both from the age and style of the construction, viewing the exposed brickwork in the few locations where this is possible, and also from the pattern of cracking in the plaster and so on, it is unlikely there are such bonding timbers in the brickwork here, but there are no absolutes in these matters and some modest allowance at least should be made in the costings for appropriate remedial works in this connection.

6.3.11 The dome appears to be steel framed, with extensive decorative plasterwork casings. The plaster has suffered cracking from water ingress and probably some thermal movement in the steelwork. Specialist plaster repairs are required.

6.4.0 **Structural Movement**

6.4.1 The building is built as a monolith, there are no movement joints or the like as are usually specified in modern buildings.

6.4.2 Nevertheless this has not been an issue. The building, considering its scale and the fact that it is built on a slope, on a clay sub-soil with varying levels and varying loadings on the foundations is remarkably free from what might be termed structural cracking or movement (as distinct from distressed plasterwork due to water ingress and other reasons).

6.4.3 The only apparent areas of what might be considered structural movement of any significance is in the lobby areas F1 and F9 on the first floor where there is diagonal cracking on the walls (See photographs P00058 for or lobby F1, P0063 for lobby F9). It is deduced from the pattern of cracking and the like that the tower, which is much heavier than the rest of the building, may have settled slightly relative to the rest of the building. Considering the age of the building and the relative weights of the tower and walls what we know about the typical soil conditions this is not a serious concern as seen over the life of the building.

6.4.4 It does, however, merit more than just filling plaster cracks and redecorating. Appropriate procedure will be spelt out in detailed specification notes, and is likely to involve stripping plaster for a width of about 1½m-2m examining the brickwork, raking out cracks, replacing any loose or fractured bricks, bonding in stainless steel bars across fractures and fixing stainless steel expanded metal and replastering.

6.4.5 A contingency will need to be allowed in case further distress is found.

6.4.6 In the ground floor lobby G2C there is cracking in the wall to the Rabbi's office G4 clear distortion and previous making good of the door to that room also.

6.4.7 This is seen as due to a different cause. There is some localised settlement, local to this wall rather than some inherent defect or movement in the whole building. The historic development plans show that this wall is an addition and may even have been built off the floor; which is cast on fill.

6.4.8 The floor of the foyer and adjacent rooms (G1, G2, G3, G4) is concrete laid on soil and rubble fill. As is usual this fill has settled over the years which is why the floor is uneven and cracked and the mosaic finish broken up in places. Alternative approaches to this include:-

- leave as is
- grout rubble under
- replace floor
- All to be discussed.

6.5.0 **Plasterwork**

6.5.1 Plasterwork is largely an architectural concern, but structural investigations throughout the building show some light on aspects of this.

6.5.2 The beam casings both to the underside of the roof and the underside of the galleries are falsework, the structural mild steel beams are largely within the depth of the floors and walls, the downstands are timber framing with plaster on lathes for architectural effect.

6.5.3 It is clear that at each column position this plaster is crushed and defective. It would seem to be a combination of movement in the framing and backing timbers, and quite possibly the result of water ingress that has run down the columns at different times over the life of the building. Considerable replacement work will be required to the plaster at all such locations.

6.5.4 It is a fundamental aspect of considering the plaster, that this distress is not particularly connected only with the current locations of water ingress, but rather where water has entered in the past.

7.0 CONCLUSIONS

7.1 The overall structural frame of the synagogue would appear to be a sound structure, stable, relatively free from movement or distress. The walls are solid brickwork of appropriate dimensions supported on steel beams on cast iron columns.

7.2 There is evidence of slight settlement long term over the 100 years life of the building, of the tower relative to the rest of the building, but while minor repairs are required this is not seen as a significant problem.

7.3 There has been considerable water ingress over the years. This has lead to distress and degradation of large areas of plasterwork, both plaster on solid brickwork and false work to beams and floors etc., but this does not appear to be associated with significant timber decay.

7.4 All the pitched roofs and flat roof coverings need to be renewed, and it is likely that the significant areas of gutter boarding and boarding to areas of flat roofs will need renewal, and at least some areas of structural timbering requiring repair and replacement when this is stripped out.

7.5 Rainwater goods, cast iron gutter, downpipes etc., require overhaul and in the most part renewal.

7.6 The water penetration has arisen from lack of maintenance and the awkward design of roofs and gutters adjacent the main central clerestory of the building, and remedial alteration and recovering works should ensure safe and easy access in the future together with access that allows for maintenance work without damaging the roof coverings.

7.7 The timber floor of the auditorium (G9) is decayed all along the north wall and requires localised remedial works.

7.8 There are a number of items that would benefit from immediate attention rather than waiting until the main documentation is prepared and formal tenders made, and these are set out in section 5.0

28-3-2006

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