Wilde
Carter•Clack

Structural Appraisal of

Malting and Brewster Houses,

Barley Mow Estate,
Barleycorn Way,
Poplar, London E14 8DE

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Contents

1.0 Executive Summary

Malting and Brewster Houses are Large Panel System buildings constructed using the TWA Larsen Nielsen method and were completed in 1968 just before the partial collapse, due to a piped gas explosion, of Ronan Point which was built using the same system.

Piped gas was removed from both Malting and Brewster Houses and steel angles installed at the base of the flank and cross wall panels, to increase the resistance of the wall panels to base shear failure, before the buildings were occupied, post Ronan Point, in 1970. The wall panels were not strengthened to enhance their flexural strength.

In 1988 prior to the construction of the Limehouse Link tunnel, appraisals of the buildings were carried out by S P Christie and Partners and subsequently by Scott Wilson Kirkpatrick and Partners. The appraisals recommended that steel angles at the base of the cross walls panels be installed to ensure the stability of the walls in the event of a non-piped gas explosion, strengthening works to the main elevations to resist self-weight loading and additional cavity ties and, that the dry pack was checked and improved as necessary.

As part of a refurbishment work and over-cladding, these recommended works were carried out in 1990 together with modification to the podium in-situ structure. This contract was carried out with ECD as Architects and Carter Clack Partnership as engineers.

It has recently been decided to replace the over-cladding and Wilde Carter Clack were asked to review the condition of the external elevations.

Additionally, since the buildings are now 50 years old, a review of the structural condition and ability to withstand a severe non-piped gas explosion in accordance with the *Handbook for the Structural Assessment of LPS Dwelling Blocks for Accidental Loading* published in 2012 by the Building Research Establishment has been carried out.

Investigation and Findings

The site investigation works have included a durability assessment of the concrete and reinforcement on the elevations and investigation in two rooms within one flat in each of Malting and Brewster House.

The investigation found that the concrete of the wall panels and floor slabs to be of good quality and comparatively high strength. The reinforcement has good cover in most locations.

Based upon these tests, it is considered that the external elevations will not suffer significant reinforcement corrosion and concrete spalling within the lifespan of the proposed over-cladding system.

Internal investigations included determining the size and type of the reinforcement in the precast floor slabs. This allowed a calculation of the capacity of these floors. The investigation was carried out by cutting into the concrete to determine the size and spacing of the reinforcement and in-situ hardness assessment to estimate the strength of the reinforcement.

Analysis based on the size and strength of reinforcement found in the investigation locations indicates that the reinforcement is of insufficient size and that under full normal service loads (dead load plus 1.5KN/m^2), the reinforcement would be overstressed.

Given the factory control conditions under which the units were produced this finding is, in our opinion, surprising.

The findings were based on investigation in only two flats and, due to the critical nature of this overstress of the slab reinforcement, further investigation is necessary to confirm these findings.

The construction of the building was then checked in accordance with the *BRE 2012 Handbook* for capacity in respect of a severe non-piped gas explosion and appraised by the BRE in respect of their specialist information in respect of this type of construction.

It was found that:

All the walls except those at the top two stories meet the required criteria for flexure and shear resistance. Indeed, the BRE suggest that based upon test data, only the top storey walls may fail.

The central floor slabs meet the criteria provided that the concrete partition wall between the bedrooms provides additional support in the event of a non-piped gas explosion.

The lounge slabs adjoining the flank walls at all levels fail and would, in the event of a non-piped gas explosion, cause destabilisation of the flank wall.

In order to minimise the risk of disproportionate damage in the event of a severe non-piped gas explosion occurring within the habitable areas of the building it would be necessary to undertake selected strengthening works.

This would include works to the slabs adjoining the flank walls, the flank walls and all the walls at the top one or two levels.

However, prior to evaluating the work necessary for this strengthening work, **it is essential that the size and strength of the slab reinforcing bars are confirmed by further investigation** in order to confirm that an overstress of the reinforcement exists under full service loads.

This investigation should be carried out in at least four flats distributed through the two buildings and also a flat in the lowest 4 levels which are non-standard.

It is vital given the findings of the investigation carried out that the possibility of a non-piped gas explosion is eliminated until strengthening measures are in place.

The use of gas cylinders or similar pressurized containers which contain volatile materials should be banned and measures should be taken by Tower Hamlets Homes to advise residents and ensure that such potentially explosive items are not used or stored within the building.

2.0 Brief

On the instruction of Giuseppe Coia of Tower Hamlets Homes Wilde Carter Clack (WCC) were asked to carry out a review of two high-rise buildings, Malting and Brewster House, which form part of Barley Mow Estate. The review would include the future durability of the external wall elevations and evaluate the building under the latest recommendations to resist disproportionate collapse as set out by the Building Research Establishment (BRE), report (BR511 - *Handbook for the Structural Assessment of LPS Dwelling Blocks for Accidental Loading*).

To inform the review, intrusive investigations were carried out on both the external wall elevations and internal structure under the instruction of WCC.

3.0 Building Description

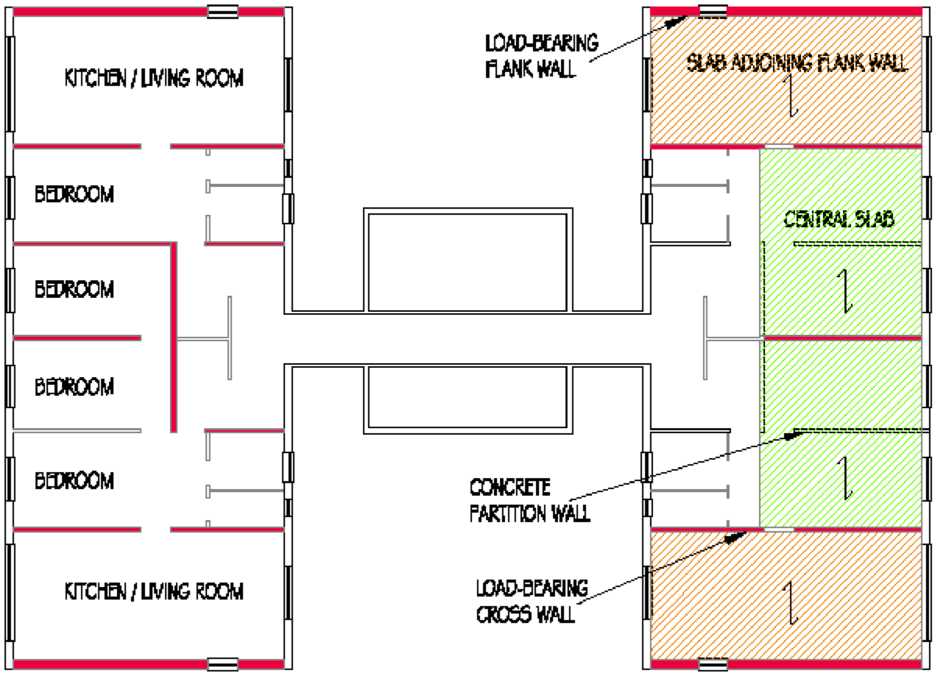
Brewster and Malting House are 14 storey high-rise tower blocks over a car park basement. The towers are of large panel system (LPS) precast concrete construction, by Taylor Woodrow-Anglia (TWA) in the late 1960's. Retrofitted steel angles were installed to the slab/wall joints to strengthen the walls before initial occupation. This followed Government advice to prevent disproportionate collapse after the partial collapse of Ronan Point in 1968, due to a piped gas explosion.

The two towers have the same floor plan and are formed of two "halves" on each side of the access core, which houses the lifts, stair core and services risers, and connecting corridor.

Each 'half' contains two flats at each level. The flats are arranged in 'three and three' habitable room pairs (from the 5th Floor and above) and 'two and four' habitable room pairs below.

The precast floors span in a north-south direction onto a series of load bearing cross walls. The east-west traverse supporting cross walls extend down to the podium slab, which is of insitu construction, over a sunken basement car park. The buildings have piled foundations.

The end or lounge slab spans from the flank wall across the Living room. The internal or central slab spans to form two bedrooms which are divided by a non-load bearing wall.



TYPICAL FLOOR LAYOUT & CONSTRUCTION

The stability of the building is provided by the load bearing wall panels. Wind in the east-west direction is resisted by the cross walls and flank walls, acting as vertical cantilevers. Wind in the north-south direction is resisted by a single spine wall (or wind wall) in each 'half', acting as vertical cantilevers.

The stability of the separate access core is similarly provided by its own wall panels acting as vertical cantilevers.
The main east and west elevation walls or window walls are non-load bearing and formed of two separate reinforced concrete leaves with insulation between. These window wall panels are supported at their ends by the cross and flank walls.

4.0 History

The tower blocks were designed by Phillips Consultants, using the LPS Larsen Nielsen method. After the partial collapse of the similar Ronan Point building Phillips Consultants designed steel angles to strengthen the walls, based on the advice from the Ministry of Housing and Local Communities.

In 1988, SP Christie & Sons carried out a visual survey of the towers including a limited inspection of two vacated flats with removed finishes. Their interim report dated September 1988, observed large voids in the dry-pack mortar and the presence of strengthening steel angles. The report concluded the building was not designed to accommodate an abnormal load of $34kN/m^2$. This higher load intensity was recommended for a severe piped gas explosion.

Also, in 1988 Scott Wilson Kirkpatrick & Partners (SWKP) carried out a detailed investigation of the buildings. Their appraisal concluded additional steel angles were required to restrain the walls and the window walls required remedial works. But they were otherwise satisfied with the building under normal loading and progressive collapse would not occur under a non-piped gas abnormal load of $17kN/m^2$. The piped gas had been removed from the building, so this was the correct loading under the then recommendations.

In 1990, Carter Clack Partnership (CCP) were engaged to carry out the recommended works to the structure as set out by SWKP as well as other works to the podium slab as part of the refurbishment.

5.0 External Cladding on Long Elevations and Flank Walls

5.1 General

The window walls on each main elevation are non-load bearing composite walls. The flank walls are of similar composite construction except the load bearing internal leaf is 152mm thick.

The buildings were over-clad in the early 1990's as part of the general refurbishment of the building along with internal flat works and external podium works.

The over-cladding was removed from the façade during the first half of 2018. This work exposed the original external concrete leaf of the precast panel which was tested by Martech to determine its current condition and possible future life. The exposed 1990's installed steel supporting brackets, plates and anchor bolts were found to be hot dipped galvanised.

5.2 Investigation

On the 4th April 2018 a preliminary inspection of the concrete cladding was carried out on Brewster House by WCC. No inspection of Malting House was carried out as the over-cladding removal had not yet started. The over-cladding was formed of a

100mm thick Sto render system with supporting rails drilled and anchored into the external concrete leaf.

During the week ending 18th May 2018 a detailed intrusive external inspection of the cladding panels to both tower blocks was carried out by Martech. Their testing included carbonation depth, chloride levels, cover to reinforcement, a hammer test to identify any cracked or defective elements and visual inspection of the panels.

Chloride
Chlorides found in cast concrete can be due to a possibility of different sources.

Historically chlorides were often use as an early strength accelerator additive. This would be especially likely in a speedy production line factory sequence and as a method to form the composite window walls which comprise of two separate concrete leaves. High chloride levels cause accelerated rates of corrosion for buried reinforcement.

Some aggregates were sourced from the sea and were poorly washed.

Chlorides can also be absorbed into the concrete from exposure to salt-borne winds and spray.

Carbonation
Carbon dioxide in the atmosphere combines with rainwater to form a weak acid. This is deposited on the structure and gradually penetrates concrete. Reinforcement in concrete is protected by the highly alkaline nature of concrete. The acid chemically reacts with the alkaline cementitious compounds and thereby reduces the alkalinity of the concrete, initially at the surface and then with increasing depth.

The carbonation depth into the concrete is measured and is compared to the concrete cover of the embedded steel reinforcement bars.

Carbonation reaching the depth of reinforcement provides the conditions necessary for the corrosion of reinforcement bars. The rate of carbonation depends upon the quality of the concrete.

5.3 Findings and Conclusion

The results indicate low concentrations of chlorides apart from a single sample and therefore the concrete cladding can be categorised as having a moderate to low chloride content.

The results indicate that the carbonation has only penetrated the concrete to a shallow depth. This is due to the good quality concrete and the EWI protection of the previous three decades.

The condition of the concrete cladding is considered to be good and given the intention to restore the over-cladding it is unlikely that significant corrosion of reinforcement will occur in the next 30 years in these conditions.

Calculations indicate the non-load bearing wind walls and support brackets perform satisfactorily under wind loading.

6.0 Structural Appraisal of the Building

The internal structural investigation was carried out by Martech in two separate phases in Flat 38 Brewster House, located on the 8th Floor, and Flat 22 Malting House, located on the 5th Floor. The first phase started on the 30th May and the second phase started on the 18th June.

Their investigation was carried out under our direction and included: concrete core testing; exposing embedded steel reinforcement for detailed measurements; testing the yield strength of the embedded steel rebar; and exposing original concrete slab, wall and in-situ mass concrete joint profiles. The findings of this investigation will be provided separately in their report.

An interim report has been provided on the floor slabs which details our findings based on the embedded reinforcement bars which were found during these investigations.

6.1 Findings

Walls

The findings of the investigations are as follows:

1.0 The concrete strength test results ranged from 33 to 73N/mm^2. Due to the wide range of the test results the characteristic strength was calculated as 21N/mm^2.
2.0 The vertical positioning bolts were found to be the pre-Ronan Point type, which were not vertically continuous.
3.0 A vertical lacer bar was located in the joint between adjacent load bearing walls panels.
4.0 A horizontal lacer bar was located under the wall in the slab joint.
5.0 Load bearing walls were measured as 152mm thick.

Slabs

The findings of the investigation are as follows:

1.0 Slabs were measured as 180mm thick with 100mm diameter cores at 150mm centres and centrally positioned within the slab profile.
2.0 A single continuous reinforcement bar was chased to prove there were no bar splices or multiple bars in the one location. Reinforcement was located at 150mm horizontal centres and positioned under the vertical rib, formed by adjacent cores.
3.0 Flank slab reinforcement was exposed across the full width of the Living Room and found to be plain round bars of 8mm diameter at 150mm centres. The bars were of mild steel strength grade. The bars terminated at the end of the slab and did not continue into the wall joint.
4.0 Central slab reinforcement was exposed across the full width of the Bedroom and found to be plain round bars of 12mm diameter at 150mm centres. The bars were of mild steel strength grade.
5.0 The transverse reinforcement was laid first into the slab at 400mm nominal centres and the main longitudinal bars laid second.
6.0 A single ribbed bar was embedded in the in-situ floor joint and is believed to be bent around the flank wall lacer bar.
7.0 Slab finishes were formed of a thin layer of compressed rockwool laid directly onto the rough precast slab, with builder's paper over and a nominal 50mm thick non-bonded concrete screed. The original vinyl tiles were glued to the screed with modern timber laminate flooring or carpet laid over.
8.0 Steel angles which were installed as part of previous strengthening works were found at wall/floor junctions as indicated on historic drawings.
9.0 The concrete strength test results ranged from $58N/mm^2$ to $73N/mm^2$ and the characteristic strength was calculated to be $58N/mm^2$.

6.2 Load bearing Walls

Normal Loading

The load bearing walls support the weight and live loads on the precast slabs and provide overall building stability from wind loads. Wind loads were applied in proportion to the size or stiffness of each of the cross walls.

Under wind loading, calculations indicate nominal tension would occur under the flank walls at podium level, where the LPS building is constructed off the insitu podium slab.

North-south direction wind loading onto each 'half' would be resisted by the single "wind wall". The wind wall incorporated a pair of coupled splice bars at each end and were found to perform satisfactorily.

Abnormal Loading
In the event of a severe non-piped gas explosion the BRE report 511 suggests an abnormal loading of 17kN/m^2 should be applied.

The load bearing walls (flank and cross walls) except at the upper levels were calculated to have sufficient capacity under this abnormal loading criteria. The BRE independent analysis of the wall panels show that the walls at the top 2 levels failed to meet the criteria for this type of abnormal loading criteria. The failure of the walls could potentially cause progressive collapse due to debris loading on the lower floor which, according to calculations, would be overstressed. The BRE suggest that test data indicates that only the top floor walls may be at risk of failure.

6.3 Slabs

Normal Loading
The slab reinforcement bars were calculated to be overstressed based on the bar diameter measured and field tests undertaken to estimate the steel yield strength. Therefore, the slabs were found to be under capacity, based on normal dwelling loading, and do not therefore comply with British Standards requirements.

A separate check was carried out by the BRE using a different approach and found no immediate danger of slab failure under normal loading conditions.

Abnormal Loading
Abnormal loading pressures of 17kN/m^2, based on a severe non-piped gas explosion, were applied to the slabs.

The central slab spans two bedrooms which are separated by a concrete partition wall.

This 63.5mm thick non-load bearing partition wall on the level above and below the gas explosion has been found to have capacity to act as a temporary load bearing wall.
If this wall provides satisfactory support, the central slabs were calculated to be sufficient to resist abnormal loading.

The slabs adjoining the flank walls were found to fail the assessment criteria under both upward and downward loading, albeit by a small margin in upward loading.

If there is a severe non-piped gas explosion in one of the rooms adjoining the flank wall, there is a significant risk that the associated slab below will fail. This will result in destabilisation of the flank wall panels and potential disproportionate collapse.

7.0 Conclusion

External Elevations

The tests results show the concrete of the external panels to be of good quality with low levels of chlorides and low levels of carbonation. The external elevations are therefore unlikely to suffer reinforcement corrosion and concrete spalling over the lifespan of the proposed over-cladding system given the proposed environmental conditions.

Cross Walls and Flank Walls

Under normal vertical and wind loading the cross and flank walls were found to satisfy the requirements of the British Standards.

An accidental loading criterion of 17 KN/m2 was adopted to assess the building since it does not contain piped gas.

Under this load, the walls at the top two levels were, however, found to fail.

Slabs

Under normal loading the flank and central slabs were found to have undersized reinforcement and therefore to be under capacity in accordance with British Standards.

The BRE has checked the slabs using a method which was different to the British Standard and found them to be sufficient.

It is recommended that THH should inspect the flats to ensure slabs are not overloaded by storage in excess of the British Standard load of 1.5KN/m2.

Under a severe non-piped gas explosion, the central slabs were found to have sufficient capacity based on utilising the support of the dividing wall.

Under a severe non-piped gas explosion, the flank slab was found to fail under the assessment criteria. This will most probably cause instability of the flank wall and disproportionate collapse.

It is vital that bottled gas or cylinders containing similar volatile or potentially explosive materials should not be used or stored in the building until further investigation is complete and the necessary strengthening works have been carried out.

8.0 Next Steps

Additional localised investigations should be carried out to confirm the current findings on the slab reinforcement bars. **At least two additional flats should be made available for inspection in each of the tower buildings**, in addition to flats located below the 5th floor which are of a different format.

9.0 Scope of works

We have to advise that the investigation work is limited to that set out in the report. We have not inspected those parts of the structure which are covered, unexposed or inaccessible and we are therefore unable to report that any such part of the property is free from defect. Latent defects may exist in the structure which can only be discovered by further detailed investigation.

Appendix

Building Research Establishment commentary and spread sheets.

‘The accompanying figure shows the locations of the various wall and floor ‘Types’.

In summary, based upon the preliminary information obtained from only one flat in each block, we have the following comments to make.

Floor Slabs

Lounge (Floor Type 1-1)
Likely to be able to accommodate the upward loading associated with 17 kN/m^2 flexural criterion, albeit being slightly overloaded (factor of 1.1) – dead-weight of slab/screed acting against the upward overload. However, it is calculated to be grossly overload (factor of 3)) in downward flexure due to the presence of a small provision of tension steel and the additional dead weight of the slab/screed acting with the downward overload pressure.

Bedroom 1 or 2 (Floor Type 1-2)
If we assume that the thin partition between the bedrooms in the storeys immediately above and below the site of an explosion can accommodate the vertical compressive loading being imparted by the 5.35 m long floor slab as it moves upwards/downwards (Robert has previously calculated that this partition can carry the vertical load without ‘buckling’), then we might assume that the floor slabs above/below a bedroom is/are working as a half-span. In other words it can be assumed that the bedroom floor slabs have an effective span of 2.675 m and act accordingly. Therefore on this basis we predict that the slabs should be able to accommodate the overpressure in both upward and downward flexure.

If, however, the thin partition wall between the two bedrooms is unable to carry the imposed vertical load from the floor/ceiling slab to the bedrooms (i.e. it ‘buckles’) then the bedroom 1 & 2 floor slab will be forced to act as a 5.35 m long slab. In this case it is predicted as being grossly overloaded with overload factors of 2.4 (upward loading) and 2.9 (downward loading). In this case it is very questionable whether the long span floor slab will survive in either upward or downward loading. However, lab-based load testing of a duplicate floor panel (or better still several floor slabs) fabricated with comparable concrete concrete/mild steel bars would be able to prove or disprove the current preliminary conclusion derived from simplified calculations. Alternative a non-linear FE model could be developed and run with varying material properties.

Either of these two approaches, whilst seeming expensive, may save the LA many £100ks in the long run by negating the need to carry out widespread strengthening of the floor slabs. Worth thinking about I would suggest.

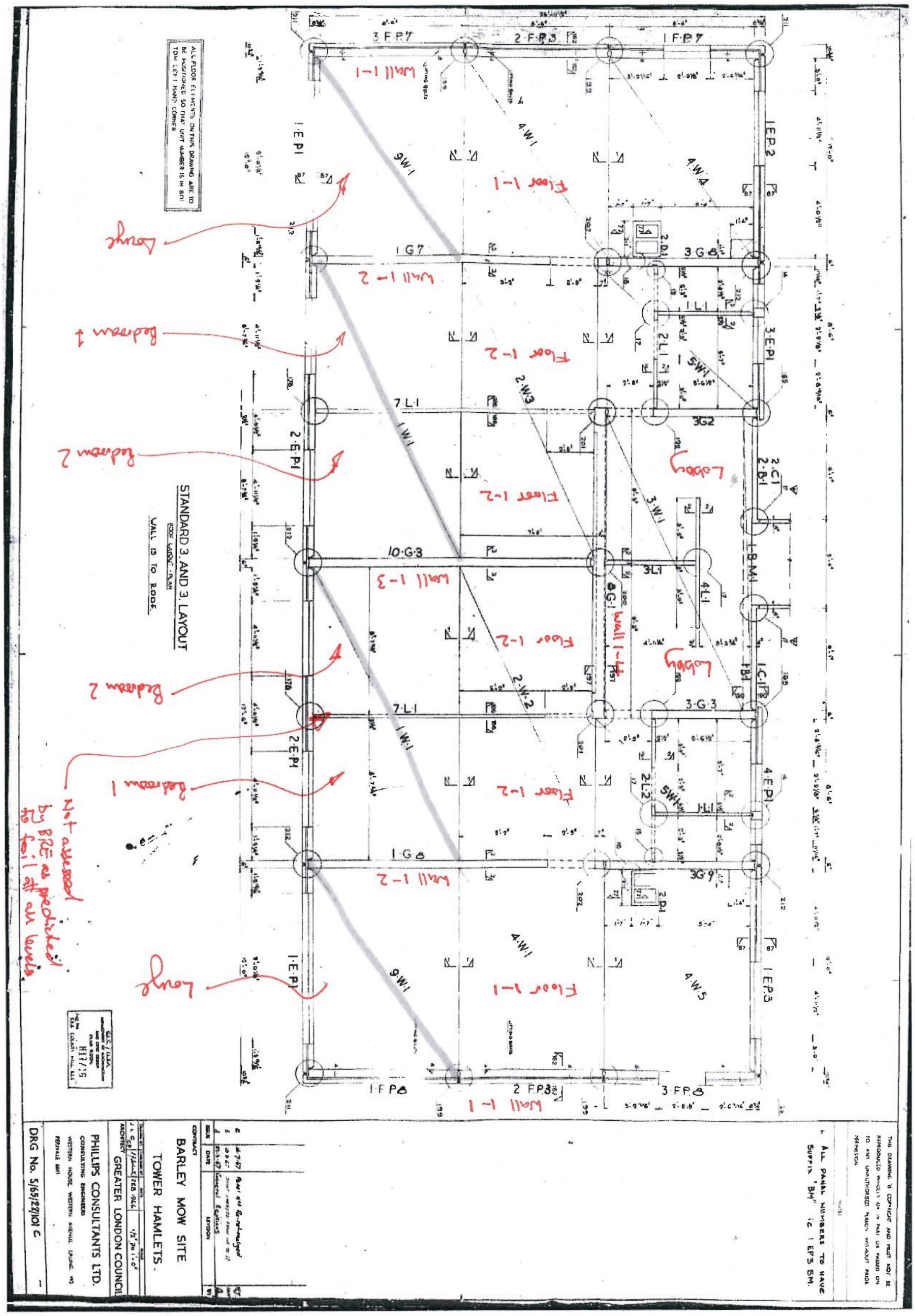
Wall Panels (ignoring presence of top and bottom strengthening angles)

The simplified calcs indicate that all wall types are at increased risk of base shear failure (sliding) on the top two storeys but in practice (based upon our load tests) we anticipate that only the walls on the top storey maybe at an increased risk of base shear failure. Of course in practice the strengthening steelwork is expected to prevent such a failure from occurring.

Wall Types 1-1 to 1-3 fail the assessment criterion for flexure on the top two storeys. In practice, however, we anticipate that only these wall types on the top storey will be at an increased risk of flexural failure.

Wall Type 1-4 (shear wall) meets the assessment criterion for flexure at all floor levels and should therefore be able to survive the over-pressure loading associated with a severe non-piped gas explosion.

The thin partition wall between the two back-to-back bedrooms has not been considered as this wall type is predicted to fail in the event of a severe explosion in one of the bedrooms due to its geometry/nature/slenderness.


STANDARD 3 AND 3 LAYOUT
BARLEY MOW SITE
TOWER HAMLETS
GREATER LONDON COUNCIL
PHILLIPS CONSULTANTS LTD.
DRG No. 5/65/22/101 C

CLIENT :	**Carter Clack**
LPS BLOCK(S) :	**TWA Blocks : Barley Mow**
Run No.	**1**
Floor Slab Depth	**180** mm

Estimated Current Concrete Strength(s)

Walls	**33.7**	N/mm2
Floors	**56.7**	N/mm2

Preliminary Structural Assessment Calculations for Floor Panels :
Overload Factors in Flexure
Accidental Loading **17kN/m2**

Moment Behaviour : Maximum Mid-span Moment
Assuming floor slabs simply-supported (ie. M = W * L^2 / K, where K = 8).

K factor	8	@

			Performance of Plain Concrete Section	Performance of Reinf. Concrete Section
			Overload Factors #	
	Flat Type 1 : End Flat - 2 Bedrooms		**Up**	**Down**
Floor Ref.	***Room Type***	*Span (m)*		
Floor 1-1	Lounge	3.66	1.1	3.0
Floor 1-2	Bedroom 1 or 2	2.675	OK	OK
Floor 1-3	Bedroom 1 & 2 (ignoring partition)	5.35	2.4	2.9
Floor 1-4	Not used	Not used	N/A	N/A
Floor 1-5	Not used	Not used	N/A	N/A
Floor 1-6	Not used	Not used	N/A	N/A
	Not Used			
Floor Ref.	***Room Type***	*Span (m)*		
Floor 2-1	Not used	Not used	N/A	N/A
Floor 2-2	Not used	Not used	N/A	N/A
Floor 2-3	Not used	Not used	N/A	N/A
Floor 2-4	Not used	Not used	N/A	N/A
Floor 2-5	Not used	Not used	N/A	N/A
Floor 2-6	Not used	Not used	N/A	N/A

 # Overload factors calculated on the basis of a minimum x-sectional area of reinforcement as derived from investigations of selected floors within the two sister blocks and floors.

@ The worst case has only been considered as the degree of fixity at the floor / wall joints approaches that of simply supported elements at higher loads.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	**CLIENT :**	**Carter Clack**												
2	**LPS BLOCK(S) :**	**TWA Blocks : Barley Mow**								Run No.	1			
3														
4		**SUMMARY PAGE : WALL PANEL BEHAVIOUR : FLEXURE AT MID-HEIGHT OF WALL**								***Estimated Current Concrete Strength(s)***				
5		**N.B. CONSIDERING EFFECT OF UPLIFT FORCES ON FLOOR SLAB SOFFIT (WHERE NECESSARY)**								***Walls***	33.7 N/mm2			
6		**SIMPLIFIED ANALYSIS**												
7														
8	**Wall Ref.**	**Floor Level**	Analysis	14	13	12	11	10	9	8	7	6	5	4
9														
10		**Flat Type 1 : End Flat - 2 Bedrooms**												
11														
12	Wall 1-1(A)	Lounge Flank wall (Ignoring effect of any strengthening angles)	Actual	Cracking	Cracking	OK	OK	OK	OK	OK	OK	OK	OK	OK
13	Wall 1-2	Lounge - Bedroom X-wall	Actual	Cracking	Cracking	OK	OK	OK	OK	OK	OK	OK	OK	OK
14	Wall 1-3	Bedroom 2/Bedroom 2 party wall	Actual	Cracking	Cracking	OK	OK	OK	OK	OK	OK	OK	OK	OK
15	Wall 1-4	Spine wall	Actual	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
16	Wall 1-5	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
17	Wall 1-6	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
18	Wall 1-7	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
19	Wall 1-8	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
20														
21														
22														
23		**Not Used**												
24														
25	Wall 2-1 (A)	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
26	Wall 2-1(B)	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
27	Wall 2-2	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
28	Wall 2-3	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
29	Wall 2-5	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30	Wall 2-6	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
31														
32														
33														

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
34	**CLIENT :**	**Carter Clack**												
35	**LPS BLOCK(S) :**	**TWA Blocks : Barley Mow**								Run No.	1			
36														
37		**SUMMARY PAGE : WALL PANEL BEHAVIOUR : SHEAR AT BASE OF WALL**								***Estimated Current Concrete Strength(s)***				
38		**N.B. CONSIDERING EFFECT OF UPLIFT FORCES ON FLOOR SLAB SOFFIT (WHERE NECESSARY)**								***Walls***	33.7 N/mm2			
39														
40														
41	**Wall Ref.**	**Floor Level**	Analysis	14	13	12	11	10	9	8	7	6	5	4
42														
43		**Flat Type 1 : End Flat - 2 Bedrooms**												
44														
45	Wall 1-1(A)	Lounge Flank wall (Ignoring effect of any strengthening angles)	Actual	Sliding	Sliding	OK	OK	OK	OK	OK	OK	OK	OK	OK
46	Wall 1-2	Lounge - Bedroom X-wall	Actual	Sliding	Sliding	OK	OK	OK	OK	OK	OK	OK	OK	OK
47	Wall 1-3	Bedroom 2/Bedroom 2 party wall	Actual	Sliding	Sliding	OK	OK	OK	OK	OK	OK	OK	OK	OK
48	Wall 1-4	Spine wall	Actual	Sliding	Sliding	OK	OK	OK	OK	OK	OK	OK	OK	OK
49	Wall 1-5	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
50	Wall 1-6	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
51	Wall 1-7	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
52	Wall 1-8	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
53														
54														
55														
56		**Not Used**												
57														
58	Wall 2-1 (A)	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59	Wall 2-1(B)	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
60	Wall 2-2	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
61	Wall 2-3	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
62	Wall 2-5	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
63	Wall 2-6	Not used	Actual	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA