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INTRODUCTION

1 In urban areas a site is often redeveloped, but in order to preserve the historical appearance of its building, planning or conservation policy may require that the existing facade is retained and the new structure inserted behind it. This facade retention may apply to one or more faces of a building. The facade is made stable by connecting it to the new structure, which may be of steel or concrete framing or masonry cross walls.

2 By the publication of this Guidance Note the Health and Safety Executive is not advocating that old buildings should be preserved by retaining their facades only. That decision must be made by those responsible for the building based on conservation views, planning requirements, structural considerations and aesthetics. Nevertheless, once a decision has been made to preserve the facade alone, it is necessary that the whole of the building be evaluated, for example in terraced domestic buildings where work carried out on one part may have an effect on the method of work for the whole structure as well as on its stability.

3 It is expected that the design of any facade retention system will be carried out by a chartered civil or structural engineer who is experienced in and has an understanding of the type of work being undertaken. This Guidance Note is not intended to be a design guide. It is intended to highlight relevant matters of health and safety for engineers and inspectors regarding the use of facade retention systems. For guidance on demolition see Guidance Note GS 29/1 -4 (Ref 1).

4 It is recommended that contact is made with the local authority, police and services suppliers before any scheme is finalised. A paper addressing this matter was published by the Institution of Structural Engineers (Ref 2).

5 Buildings normally requiring this type of work are those originally built in the eighteenth or nineteenth centuries, from three to eight storeys in height and stone faced. Windows will be arranged in fairly regular pattern and may form a large proportion of the facade area. Most buildings will be of load bearing masonry construction.

6 During the demolition and new construction phases the facade needs to be held in its original position so that it can resist the vibration and movement of construction activities, traffic and the loading from wind and weather. In order to do this various systems are used including vertical or raking shores, horizontal wind girders and kentledge. Whatever system is erected, it must be strong enough to carry the loads and stiff enough to hold the existing wall in a secure manner with minimal deflections while the new work is completed. The use, temporarily or otherwise, of original rubble-filled walls will determine the type of bearing necessary for concentrated loads to be adequately spread and supported. It will also be necessary when carrying out any fixing, supporting or bracing work that care is taken to avoid causing any damage to the facade.

ANCILLARY WORK

7 Some urban sites may have limited space for the provision of site accommodation and storage of materials. The positioning of these will need to be allowed for at the planning stage.

8 A very specialised form of shoring which is used when a whole building is to be jacked up and moved bodily on prepared slides is not considered in this Guidance Note.

GENERAL STRUCTURAL CONSIDERATIONS

9 Most of the buildings which require facades to be retained are of load bearing construction with timber floorboards supported on timber joists. The walls are likely to be reasonably thick but not necessarily of solid construction. Often the walls are constructed from a stone facing attached to a brick backing or two leaves of stonework with rubble infill. Other types of construction are also used. The walls may contain timber lintels or bonding timbers and pocket seatings for joists. The layout and detail of the new construction and the retained original facade will determine the layout and type of temporary works and the method of construction to be followed. As part of the new building work it may be necessary to remove internal crosswalks which may either be of masonry or timber stud construction. If any crosswalks or floors are to be retained, suitable ties should be designed and installed appropriately.

10 Before any major work commences, it will be necessary for a structural survey to be carried out to determine the layout, construction and condition of the existing building. The survey will also determine how structural stability is being achieved. Structural design of the new building should ensure that the building can be constructed safely with particular consideration given to how stability of retained parts of the existing building can be achieved during demolition and reconstruction.

11 The site layout and surrounding road and pavement pattern including cellars, pavement lights, services and basements will to some extent determine the spread of the base of the shores. In general, the greater the spread of the base of the shores the lower the loads in the structure and the foundations. In some cases the type of road adjacent to the site or the surrounding services and their access may limit the system to the use of a pavement frame only with no encroachment into the road at all. In other cases road closures may be necessary to accommodate the chosen system. Whatever the layout, the temporary frames will need to be protected from damage from vehicle impact. The provision of timber kerbs, barriers and lighting will be necessary to conform with local authority requirements.

12 The normal street gutter and gully drainage may well be interrupted by the shoring structure and foundations. Consideration should be given to providing temporary drainage, eg by the provision of pipes cast into the foundation blocks to allow the water to drain away.

13 Old walls properly braced by crosswalks and floors may have stood satisfactorily for many years on what may now be regarded as poor or undersized foundations. Even though the load on the facade wall will be reduced, a check may be required to determine the load carrying capacity of the existing foundations and a site investigation may need to be carried out. It may be necessary to carry out remedial work or underpinning to the existing construction before other work can proceed. In buildings with cellars or basements substantially below surrounding ground level, removal of the ground floor and internal walls will probably necessitate provision of internal raking or flying shores to prop the basement walls as part of the demolition work.

14 The existing windows will generally be removed and the resulting holes may need to be braced or temporarily filled. Temporary vertical props or bricking up of thinner areas of walls or chases may also be required so as to maintain the integrity of the wall in its temporary condition. An investigation of chimney flues should be carried out and any similar making good or filling decided upon. Many old buildings have chimney flues in the thickness of the facade wall. However, the presence and location of these may be difficult to detect due to installation of central heating and subsequent removal and sealing of fireplaces and capping of external flue openings. Buildings with basements sometimes incorporate ventilation ducts in the facade walls. Location and making good or filling of these flues/ducts is best carried out when the original floors are available for access and before internal demolition commences

15 Any unexpected voids in the masonry or other matters not in accordance with the drawings found during subsequent construction works should be immediately reported to the designer of the shoring and the structural designer of the new building in case they adversely affect the integrity of the facade. It may be necessary for voids in rubble-hearted walls to be grouted solid and this should be carried out by a specialist. The filling of joist and lintel pockets may also need to be made good. Any necessary foundation work will need to be carried out before the major work begins.

SHORING

16 Once the self-weight can be assumed to be suitably supported, the greatest load to be carried by the shoring system is that caused by the wind. In the design of the system the intensity of wind load, the size of the facade holes and the load factoring should take account of the likely life of the system. The loads and load factors must be appropriate to the anticipated length of time the shoring system is expected to be in use. Generally the design load will be the appropriate wind load plus 2.5 10 of the dead load of the facade. The method of connecting the shoring to the facade wall must suit the construction of the wall.

17 It must be realised that during the demolition phase and other interim phases of the work, wind loads may be increased or differ from those taken by the original building. This variation may be due to walls which may have been sheltered originally or the funnel effect due to the removal of existing walls. Design heights of walls may be increased due to the removal of floors.

18 The design of the temporary shoring system will be dependent on the position and number of walls to be retained, the layout of the existing building and the position and number of new floors. It is essential that any internal shoring can be erected easily within the confines of the original building so that demolition can be carried out safely and that the new structure can be erected or built clear of the temporary shoring work. Guidance Note GS 28/1-4 may prove useful (Ref 3). The installation of the shoring and removal of structural walls/floors must be carried out in a predetermined sequence to ensure that the integrity of the structure is maintained throughout the demolition phase. Similarly, any removal of internal shoring should be phased in with completion of the new internal structure and its bonding to the facade. Finally, when the new building and existing facade have been connected together structurally, the temporary shoring can be removed safely.

Wind girders and flying shores

19 The use of horizontal wind girders or flying shores is dependent on there being adequate existing return walls or other means to carry the loads down to ground level support which may be road or basement level. The use of wind girders may ease the temporary structural design, but their use may impede the carrying out of the new construction work.

Vertical raking shores

20 If wind girders or flying shores cannot be used, the vertical raking shores must be designed as cantilever frames to carry the worst combination of loads imposed on them and particularly the wind loads in both directions (Figure 1). The shores may have to be designed to resist both compression and tension in the members and joints and the foundations to be capable of resisting compression and uplift with a sufficient mass of concrete, kentledge or other means used to resist any upward load. Foundation bolts will need to resist the shear and uplift forces. Deflections must be limited to preserve the integrity of the retained structure.

Shoring methods used

21 Vertical shores may be made from conventional scaffold tube and fittings or bridging trestles. Windows and other openings can be braced, the scaffolding or timber dependent on the size of the opening involved.

22 The construction of wind girders and shores can be found using scaffold tube, structural steel or

proprietary systems (Figures 2 to 5) or any combination of these. Scaffold tube has the advantage that it can be used and adapted to suit the conditions found on site. Because there is a limitation on the load carrying value of tubes and couplers it may be necessary to use multiple members. In this case the use of scaffold tube may become unwieldy in larger shoring systems. One disadvantage is the multiplicity of joints.

23 Structural steel sections for shoring or frames can be chosen to suit the loads involved but surveys must be made prior to fabrication and allowances made for wedging and tying the existing structure. Decisions as to what system or combination to use will usually be made by the contractor's designer on a basis of safety, cost, site conditions and suitability for the method to be used and the type of construction.

24 One recent system has used a reinforced concrete services tower to afford stability for the facade walls after demolition of the original internal structure. The tower is used to support the horizontal struts and ties, providing support to the external facade walls (Figure 6).



Figure 1 Proprietary system side frames. Note the use of horizontal wind girders connected to the side frames.

Figure 2 Scaffold tube and coupler system. The general public is excluded and the base of the shore is protected.

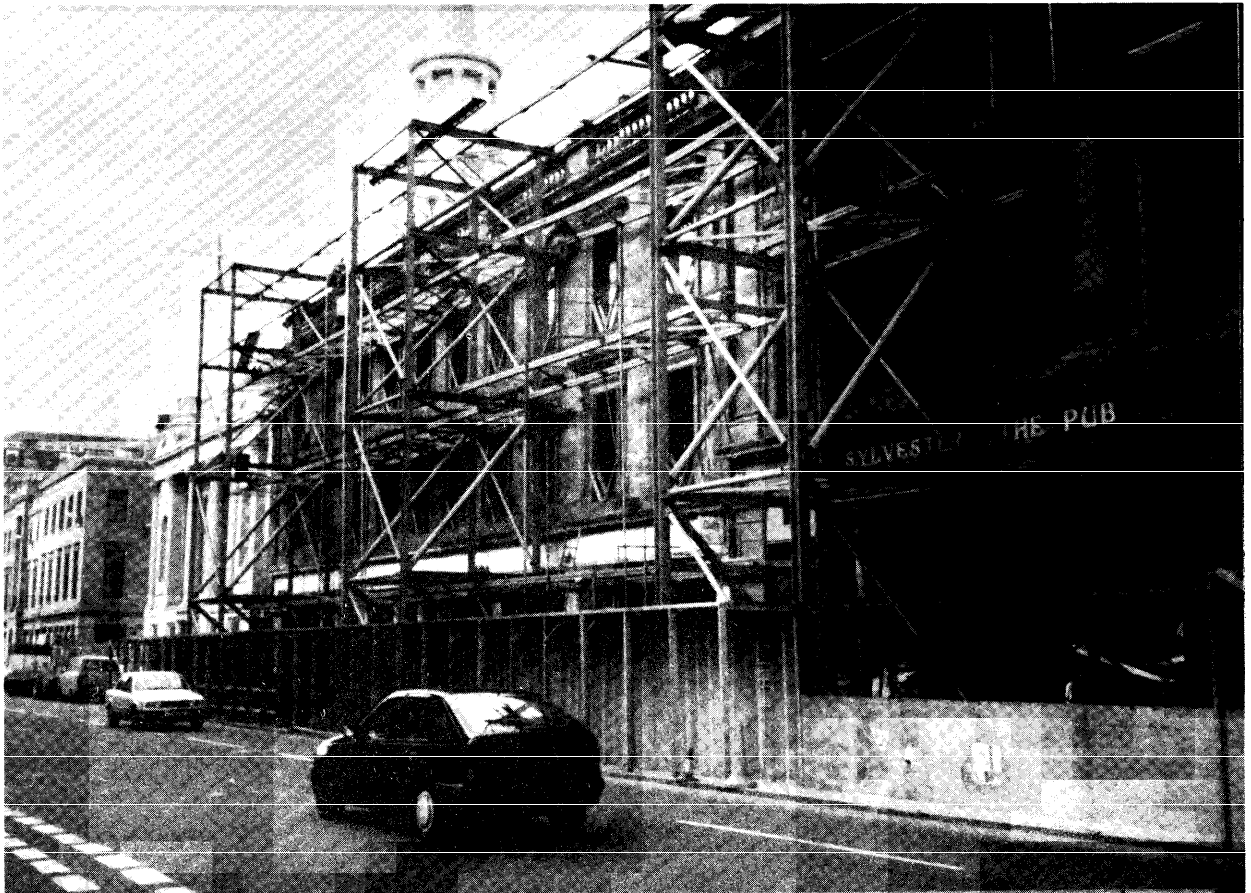


Figure 3 Structural steel frames used for towers.

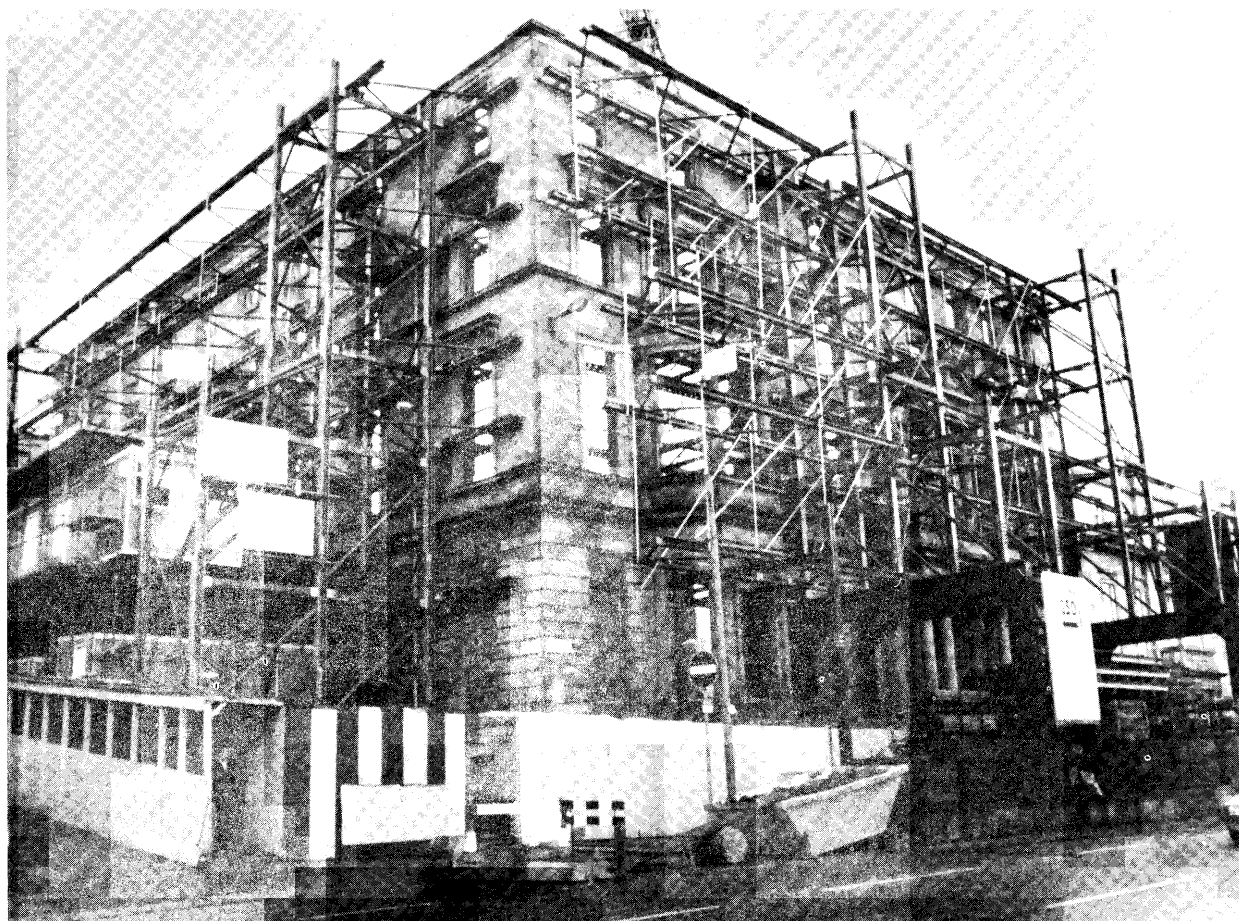


Figure 4 Massive steel frames used at ground level with protection of the base. Note pedestrian access on left.

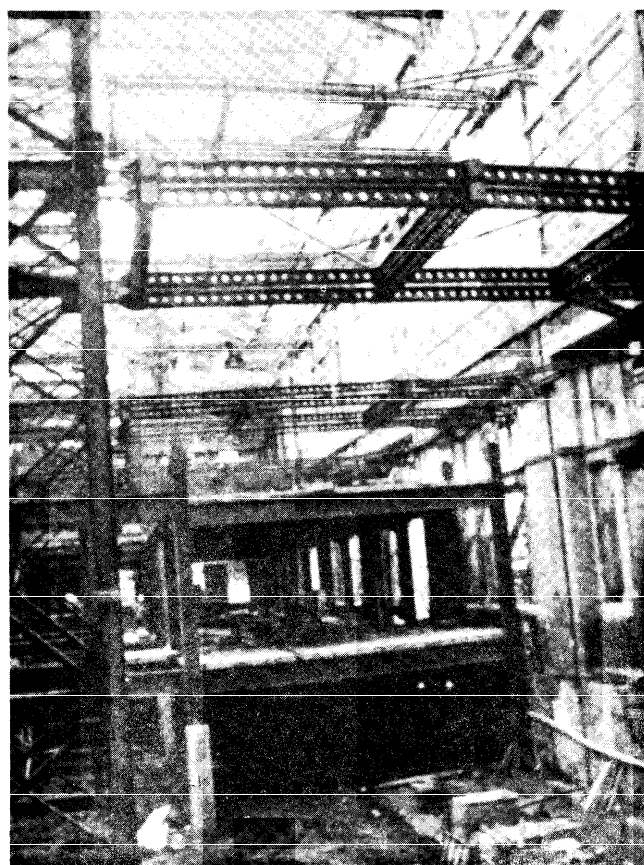


Figure 5 Proprietary system. Braced struts in use from facade wall to structural steel framing.

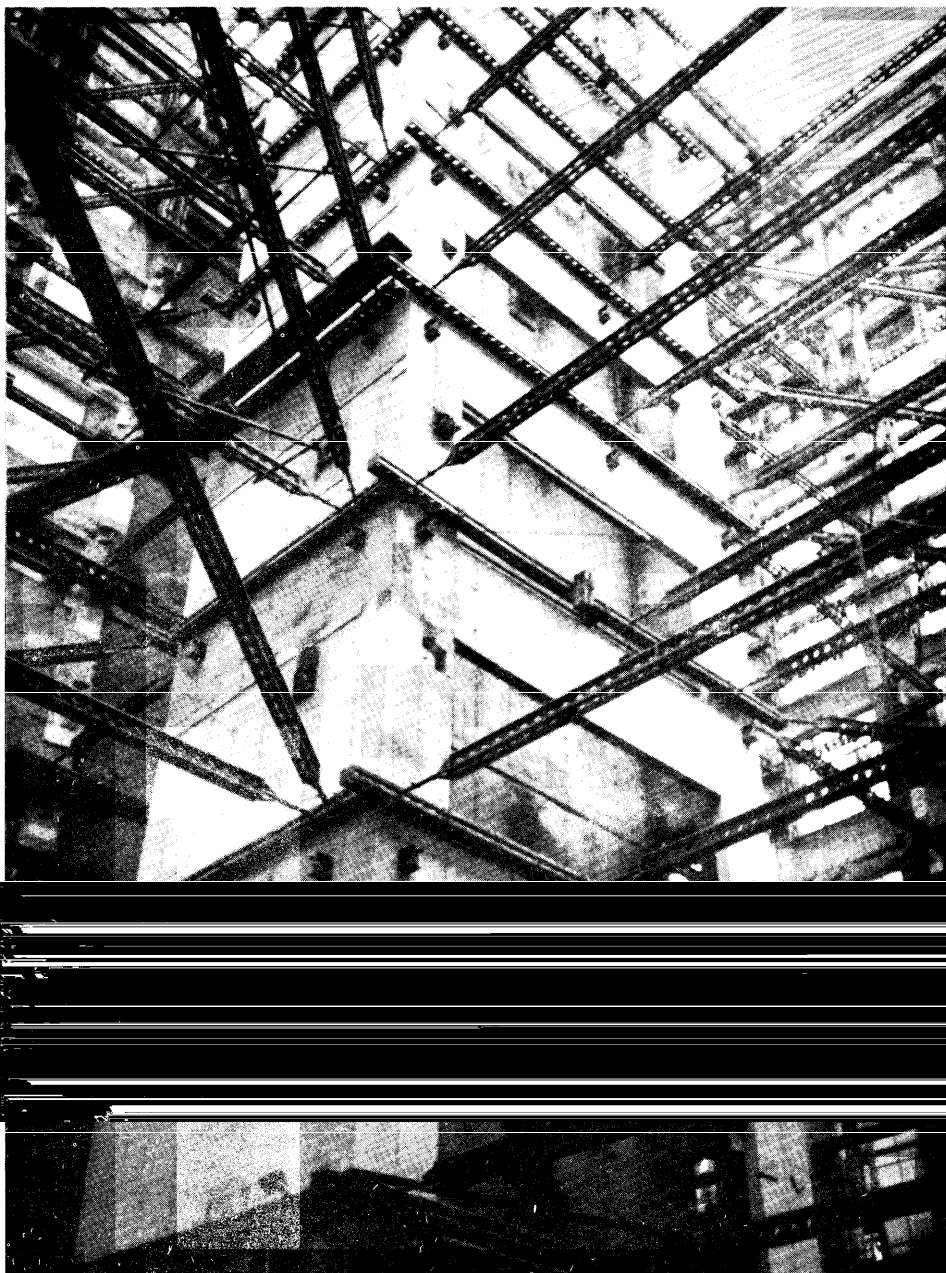


Figure 6 Reinforced concrete services tower affording support to horizontal struts.

ACCESS

25 Safe access will be necessary for site personnel for the preparation and erection of the temporary work (see Guidance Note GS 15 (Ref 4)). If conventional scaffold tube and fittings are used to construct the shoring, it is often useful to incorporate a general purpose scaffold in the external shoring to provide access during demolition work and working platforms during reconstruction work. Wind girders and flying shores may be erected using the original structure as access and external shores may be erected from the shoring system itself or by means of separate scaffolding. Once the original structure is demolished, access to the shores and other parts of the temporary work should be considered in the method statement.

Regular inspections and maintenance of the system itself and any making good of wedges and ties must be possible from a safe place of work in accordance with the Construction Regulations (Ref 5).

26 While it would be preferable for the general public to be kept wholly clear of the work, it may be necessary for access to be maintained along an adjacent footway. In such cases the base of the shoring system may incorporate a pavement bridging section from which the main shoring will spring. Protection of the public from falling objects together with the provision of warning notices, lighting and suitable walkway floors will be required. The use of protection fans, debris netting or sheeting on any scaffolds will also give protection.

INSPECTIONS

27 It is recommended that an initial handing over of the shoring system should be carried out. A competent person must inspect the system as any other access scaffold would be inspected and the inspection must be recorded. The integrity of the system, including the soundness of the tying or wedging methods used, must also be regularly inspected as should the integrity of the support of the bases and their protection from vehicle impact as well as any lighting used.

28 If cracks or movement in the retained facade appear, these should be monitored. It is important that the crack patterns to be monitored are interpreted correctly. For example, where cracking indicates delamination or suggests that in other respects that masonry is losing its integrity, there may be a need for immediate remedial work. Monitoring alone is only appropriate when it can be shown that continued movement will not precipitate collapse. It must be understood that there should be time to implement remedial works should the situation deteriorate.

29 After the occurrence of any severe weather conditions, which could have affected the strength or stability of the shoring system, an inspection should be carried out by a competent person, recorded as required and any notification made to the responsible person.

GENERAL

30 In addition to facade retention there may also be a need for other temporary work to be incorporated. The

removal of the original building may expose other existing walls which may need temporary protection from the elements or making good so that the integrity of the adjacent wall is maintained. In a similar manner the provision of temporary rainwater downpipes and facilities for pumping out basements may have to be part of a facade retention scheme.

31 The connection of the existing facade wall to the new work is essential and may be carried out either as the work proceeds or as one complete exercise. This is usually by means of a structural connection between new and old parts of the structure or by the use of long bolts right through the existing wall thickness. Some form of proprietary grouting may be used in either case and it is vital that the work is carried out in accordance with the designer's and manufacturer's instructions. A proportion (25% is recommended) of the connections must be tested before work proceeds in dismantling the temporary shoring system. It is equally important that there is a proper system of work for this as it was for the original erection and demolition.

32 Although bonded anchors may be acceptable in some situations to connect new and old, the condition and type of wall may require that through bolts be used. Similarly it must be expected that there can be a degree of differential settlement between the old and new structures and the connections should be able to accept this.

33 Where resin fixings are to be used, it is essential that type tests are carried out before use to prove that the chosen fixing is adequate and that the fixings are firmly anchored in the facade.

REFERENCES

- 1 Guidance Note GS 29 **Health and safety in demolition work**
Part 1: preparation and planning
HMSO ISBN O 118854054
Part 2: legislation HMSO ISBN O 118835890
Part 3: techniques **HMSO** ISBN O 118836099
Part 4: health hazards HMSO ISBN O 118836048
- 2 Goodchild S and Kaminski M P 'Retention of major facades' *The Structural Engineer* April 1989, VOI 67, no 8, pp 131-8
- 3 Guidance Note GS 28 *Safe erection of structures*
Part 1: initial planning and design
HMSO ISBN O 11 883584X
Part 2: site management and procedures
HMSO ISBN O 118836056
Part 3: working places and access
HMSO ISBN O 118835300
Part 4: legislation and training
HMSO ISBN O 118835319
- 4 Guidance Note GS 15 *General access scaffolds*
HMSO ISBN O **118835459**
- 5 *Construction (General Provisions) Regulations 1961 S1 1961/1580* HMSO ISBN O 11 1001439
and *Construction (Working Places) Regulations S1 1966/94* HMSO ISBN O 11 1002648

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