3. **HASTINGS BOYS' HIGH SCHOOL ADMINISTRATION BUILDINGS, HASTINGS, HAWKE'S BAY, NEW ZEALAND**

I.J. Garrett*

Client: N.Z. Department of Education

Consultant Services by Ministry of Works and Development

Contractor: J.C. Mackersey Ltd., Hastings

- sprayed concrete by K. Sulzberger, N.Z. Dairy and Industrial Supplies, Hamilton.

Original Structure:

This is a two-storey cavity-brick construction with a part basement, built in the mid 1920's. Reinforced concrete bands (longitudinal reinforcement only) were provided at lst floor and eaves levels. Ground and first floor are timber and the roof timber framed covered with Marseilles type clay tiles. Ground floor areas are divided into relatively small spaces.

The upper levels of the high brick gable walls were replaced in timber construction after their collapse in the 1931 Hawke's Bay earthquake. Also concrete and reinforcement were placed in cavities at upper levels of the piers. These piers were constructed with cement mortar, but walls were in lime mortar which was shown to be very weak during demolition of a single storey classroom wing built at the same time as the Administration building. Butterfly type wire cavity ties were originally specified every fourth course at 3 foot (900mm) centres.

The building style (Cape Dutch) was regarded as having architectural merit; for New Zealand the building can be regarded as having "historic" attraction and re-use of the building for school administration was functionally feasible. Upgrading was also considered relatively attractive for cost reasons.

Strengthening considerations in the late 1970's were based on NZS 4203:1976 (Design Loadings Code) with a seismic lateral coefficient of C_d = C I S M R = 0.15 x 1.3 x 1.6 x 1 x 1 = 0.312.

Primary aims were to preclude a major collapse and inhibit the loss of veneers. The walls were to act in shear with face loadings transferred by means of a concrete beam at first floor level, while diaphragm action at each level was also enhanced. No allowance was made for shear strength in the brickwork.

Retention/protection of the veneers was given considerable attention. Tests using an expansive grout mix developed by MWD Central Laboratories were carried out in 1979, and were exceptionally successful at bonding the veneer to the main wall. Another concern was the possibility of efflorescence. However as

(a) ingress of moisture to the top of the wall is prevented by the roof, and

(b) the large eaves overhang also minimises the wetting of the walls, and

(c) the bricks themselves were very dry and absorbent,

it was considered that there was likely to be insufficient water available to release the calcium salts producing efflorescence. To date no problems have been reported.

Because of the extremely dry and absorbent nature of the bricks, prewetting of the cavity faces was required. The rate of filling had to be carefully watched to ensure that insufficient hydrostatic head developed that could "blow" off the veneer at any planes of weakness. All cavities were filled wherever access could be gained.

The structure was strengthened for in-plane and face loadings by forming reinforced concrete walls, using sprayed concrete, on inside faces of the existing walls. Footings were widened at the base, in poured concrete to spread the load of the extra weight added to the buildings. A poured concrete beam was also provided at first floor level. (see Typical Section attached).

To ensure good bond of the concrete to the walls, all paint and plaster was removed from the brickwork using wire brush and compressed air. The inside layer of mesh was positioned and wall anchors installed into drilled holes filled with an epoxy resin inserted with an air operated cartridge gun. After setting of the resin the mesh was welded in position, the outside layer of mesh placed and then the permanent screeds fixed to angle brackets held by drilled-in anchors. This phase of the work is labour intensive,but it is extremely important to have the reinforcement firmly fixed. For application of the sprayed concrete it is also important to have an experienced team. Prevention of overspray, shadowing, excess rebound, sloughing off, underspray, poor concrete mix, low density, etc. all are the responsibility of the nozzleman. Good communications with the pump/supply point is also essential. Evaporation of moisture was a problem on some days and extra water was necessary to maintain operability. Insitu density compared favourably with those of test cylinders, and seven-day cylinder tests were in excess of specified 28-day strengths. It is understood that not all applicators can achieve the levels required. In general, as there is likely to be some lack of compaction at the surface, it was

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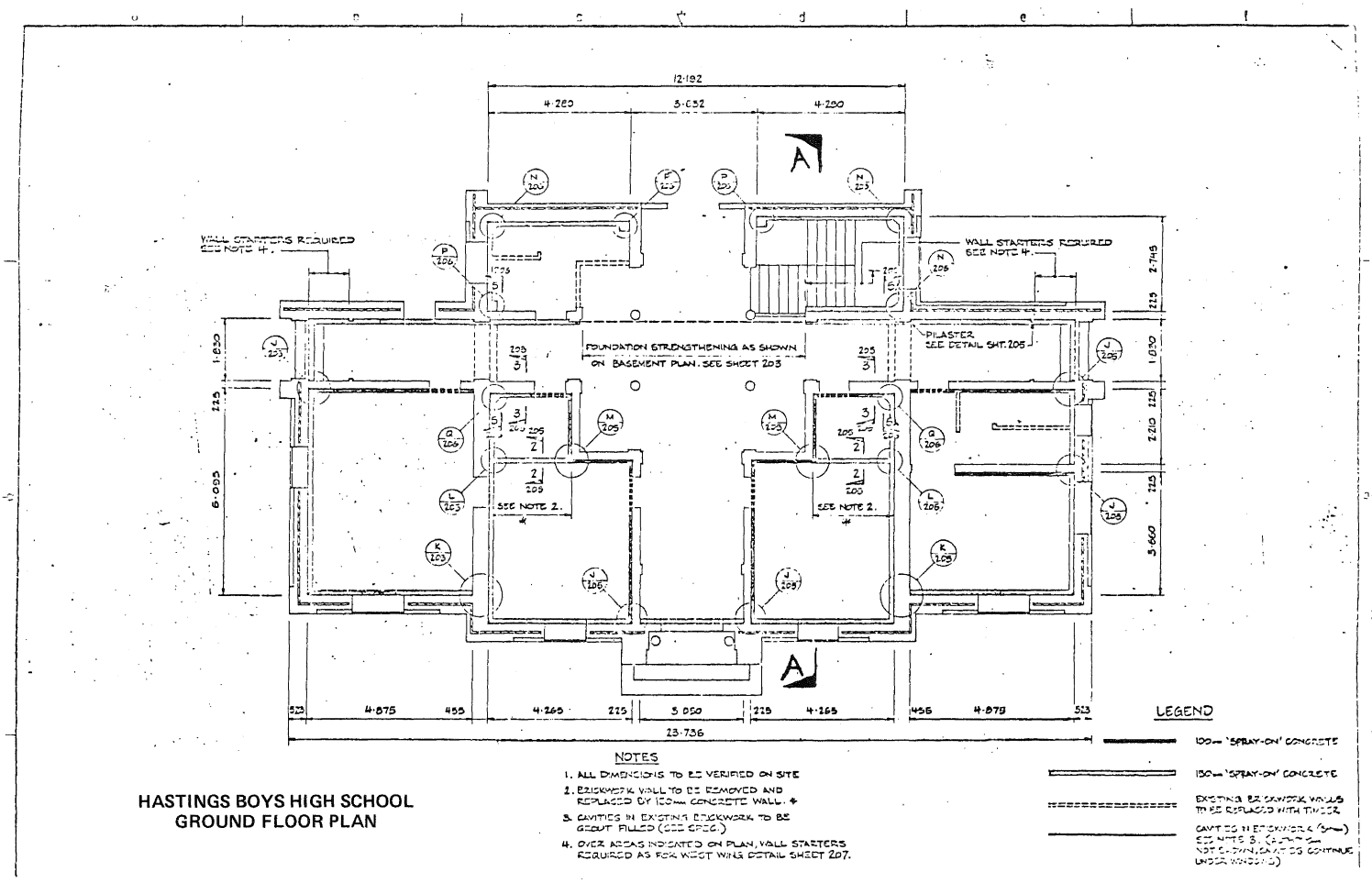
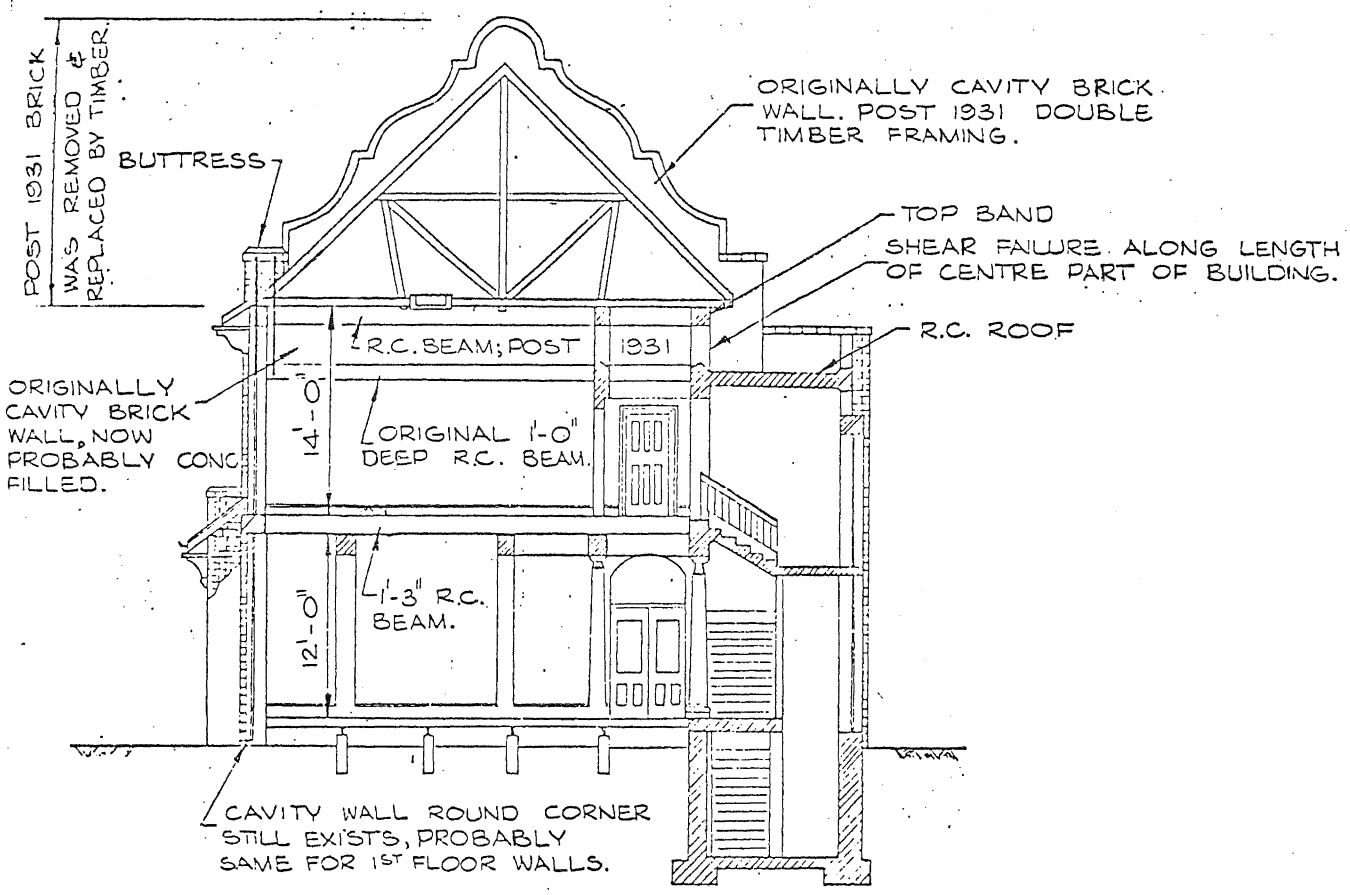


NOTES

1. ALL DIMENSIONS TO BE VERIFIED ON SITE
2. BRICKWORK WALL TO BE REMOVED AND REPLACED BY 150㎜ CONCRETE WALL. ✱
3. CAVITIES IN EXISTING BRICKWORK TO BE GROUT FILLED (SEE SPEC.)
4. OVER AREAS INDICATED ON PLAN, WALL STARTERS REQUIRED AS FOR WEST WING DETAIL SHEET 207.

HASTINGS BOYS HIGH SCHOOL
GROUND FLOOR PLAN



A – A

1/8" = 1'-0"

considered prudent to neglect the outer 25 mm of wall thickness for strength calculations.

Because the alignment of brick faces against which the reinforced concrete was to be placed was hidden by plaster at tendering time, it was considered prudent to allow for an average of say 10 mm excess to cover the variation in thickness. A finished surface for painting could not be achieved without plastering.

There is a small basement which was partially stripped for lining the walls with sprayed concrete, to line up with the walls above. One wall which was lined with Neuchatel bulged and then burst, providing a small fountain. This was eventually sealed and seepage confined to a small area. Drains were provided, to the sump pump, for pressure relief - seepage quantity is low and now handled by the existing sump pump.

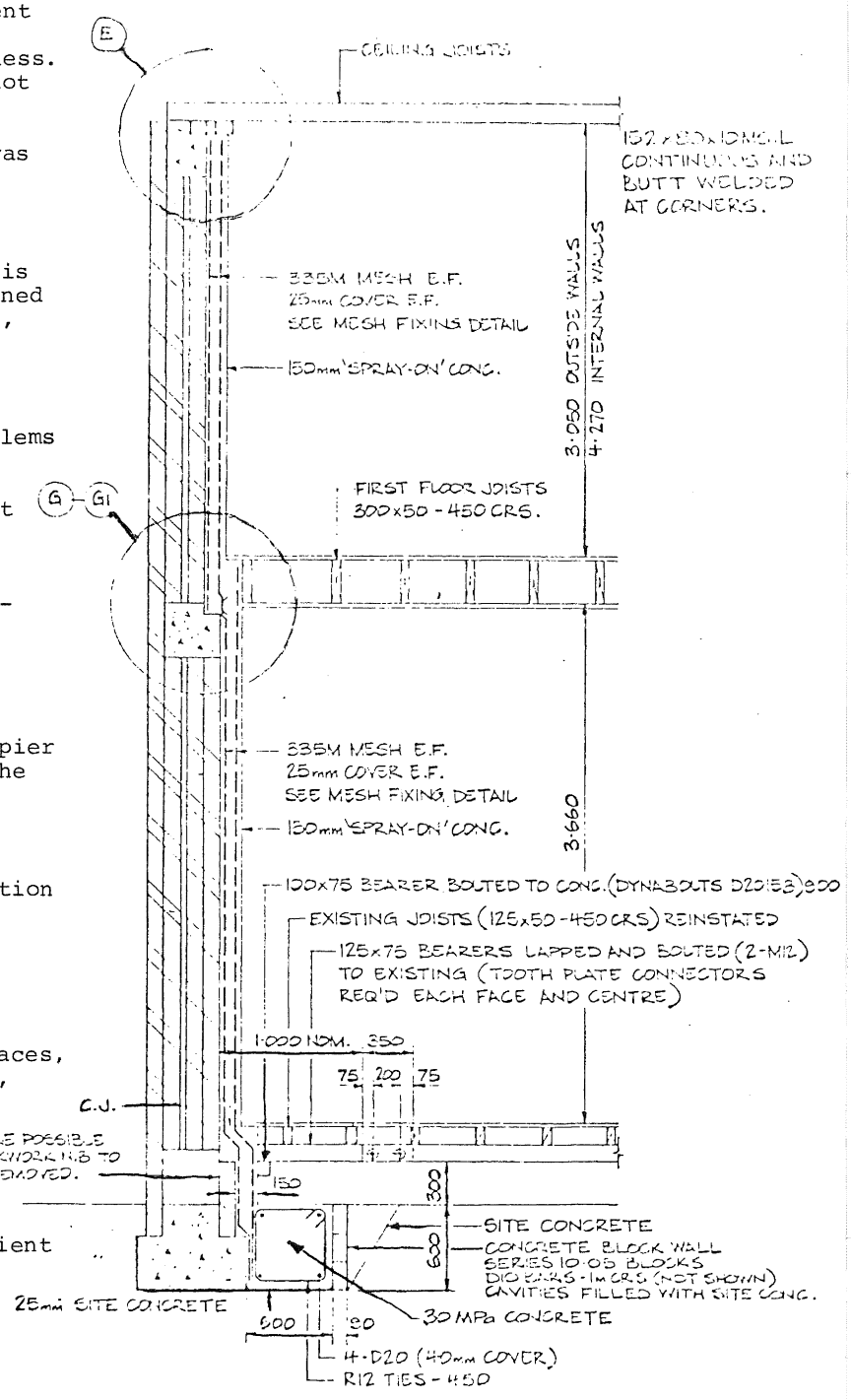
Relatively few unanticipated problems were experienced on site, but minor variations were considered inevitable. Post 1931 reconstruction involved cement plaster rendering to brickwork. This adhered well to the walls and so paint was removed and the surface roughened. The work is labour intensive, and super-vision of above normal levels was provided to assist when problems were found and also to ensure that work was executed to the specified requirements.

Both the design team and the occupier regard the job as being successful. The efforts and cooperation of all parties were essential in achieving that end result.

As in many such cases the realization of original aims depend largely on attention to detail. Here particular care must be taken with adequate fixing of dowels and starters, firmly fixed mesh, "basketting" reinforcement, prevention of spraying shadow areas, clean construction joints and wall surfaces, overall control of the sprayed concrete, and general care with all concrete and grouting operations.

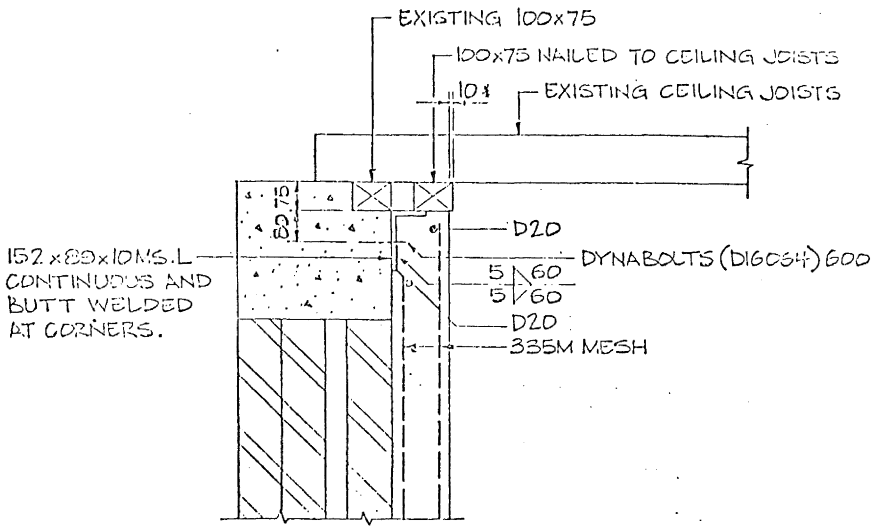
The cost of the total job was estimated at approximately 60% of that of a replacement standard building. Variations in the basic seismic coefficient had relatively minor impact on the structural costs involved.

Finally, it must be remembered that much of the technology involved is new and some conservatism in the use of innovative techniques is warranted. Quality control, sampling and checking at all stages must be considered an essential part of the design, specification and contract operations to ensure that the required end results are achieved.



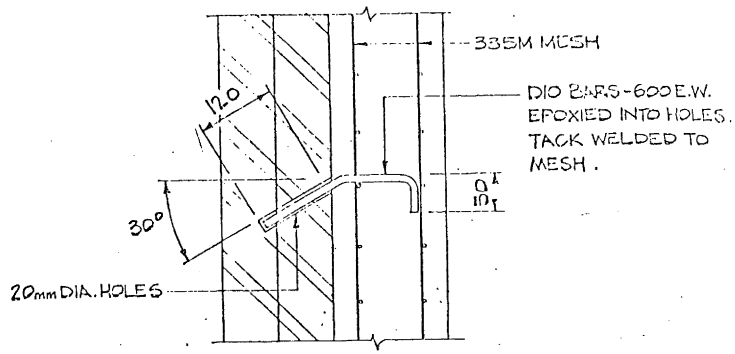
TYPICAL SECTION - 150mm 'SPRAY-ON' CONC.

1:25



DETAIL E

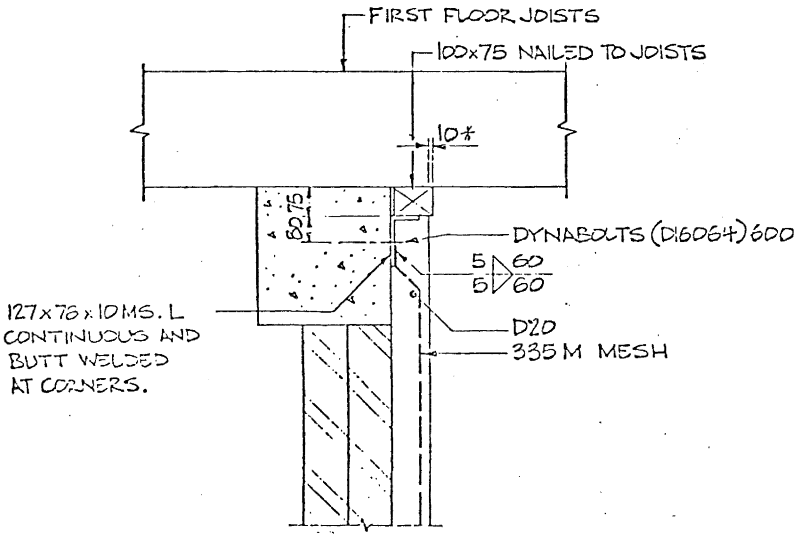
* 10mm OVERHANG FOR PLASTER FINISH. SEE ARCH. SHT. 108



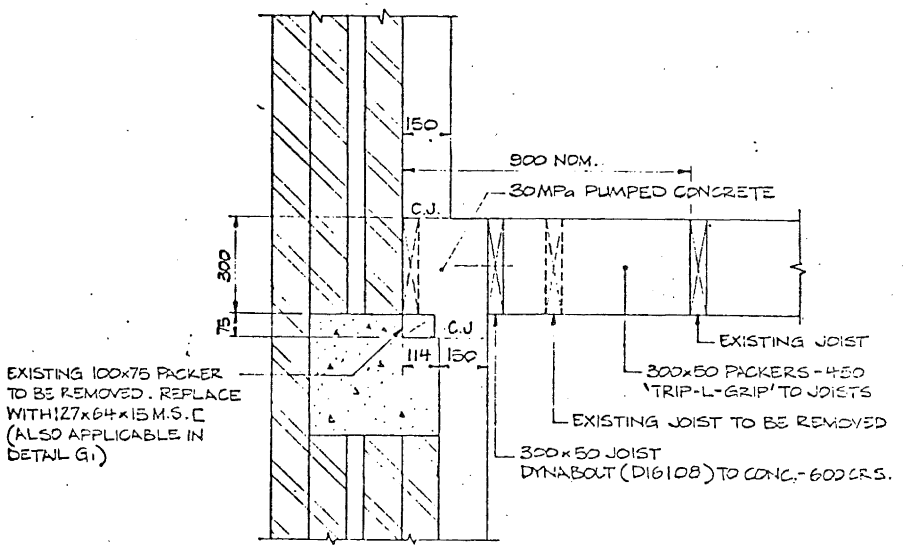
MESH FIXING DETAIL

1 : 5

NOTE: DRAWN FOR 150mm 'SPRAY-ON' CONC. SIMILAR FOR 100mm AND 75mm CONC.



DETAIL F



DETAIL G - JOISTS PARALLEL TO WALL

NOTE: REINFORCEMENT AS FOR DETAIL G1.