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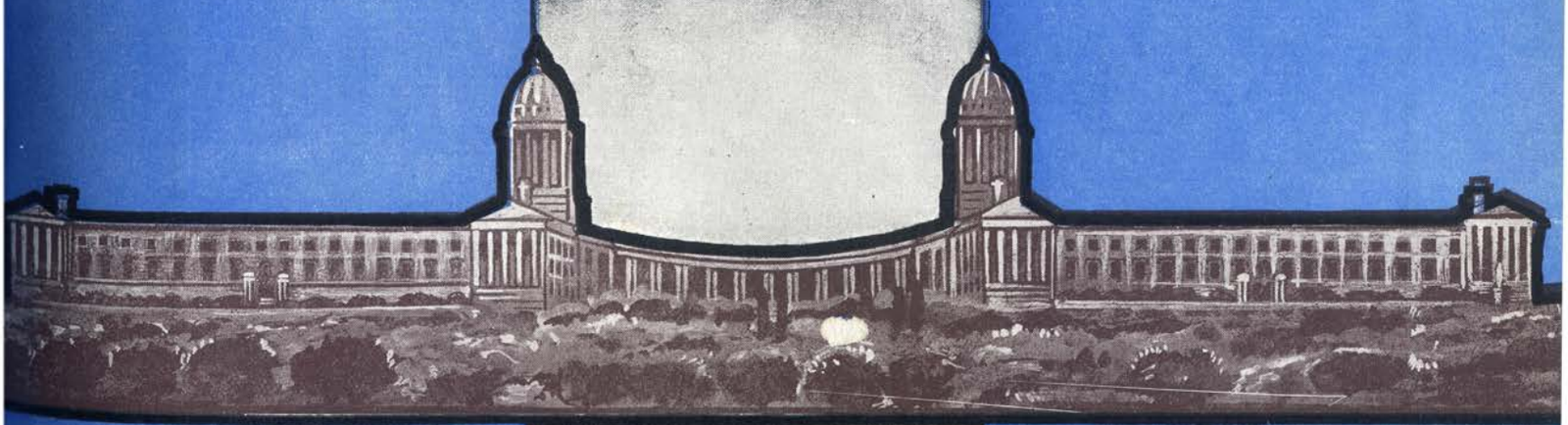
PUBLIC WORKS OF SOUTH AFRICA



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"PUBLIC WORKS OF SOUTH AFRICA," which is published monthly, is intended to keep the public up-to-date in regard to projects of the Public Works Departments of South Africa, Union, Provincial and Local Government, giving expression to the activities of each of these departments of service.

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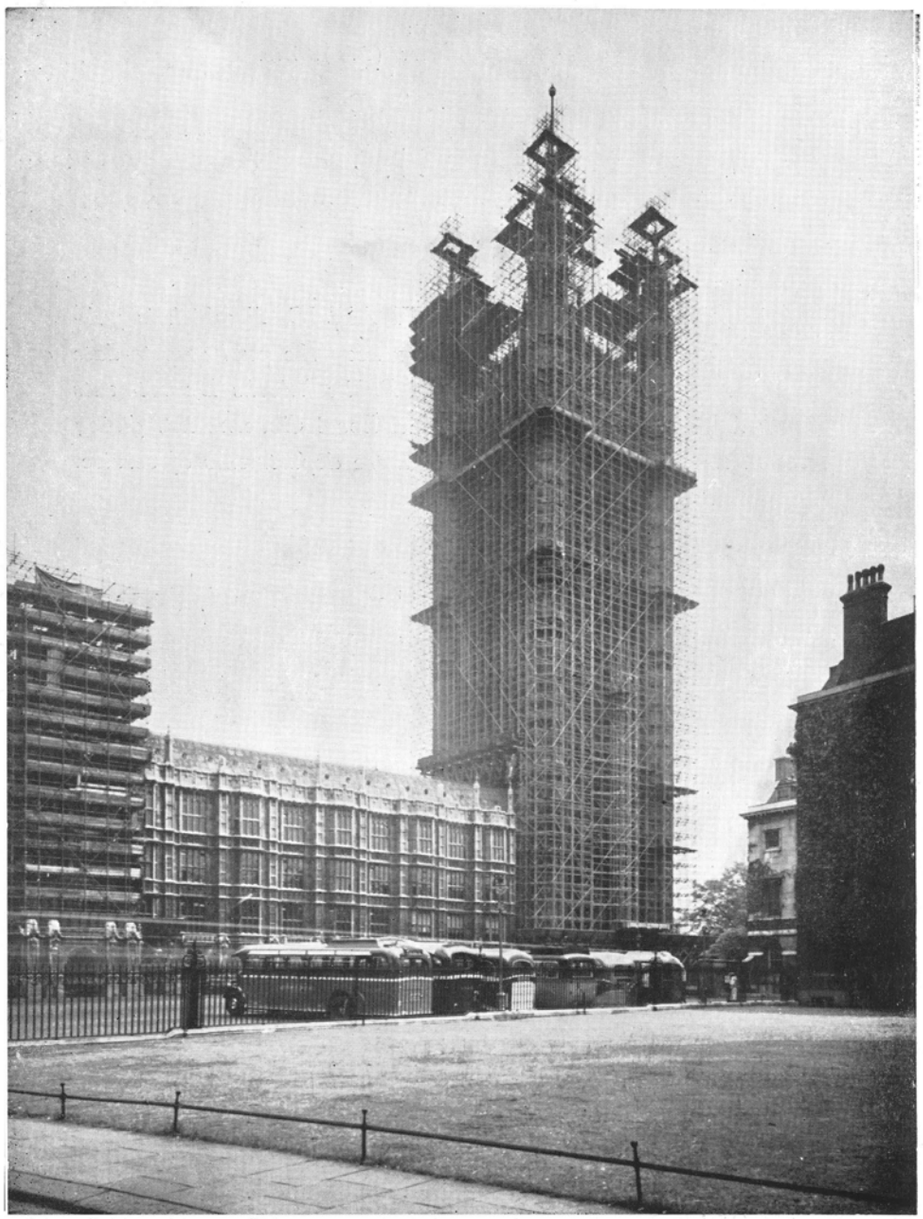


The . . .
Victoria Tower

The steel scaffolding surrounding the Victoria Tower, 340 feet high, is believed to be the highest erected in Great Britain. The work of repair to this Tower is expected to take four or five years.

HOUSES OF PARLIAMENT —— WESTMINSTER

Fifteen Years' Task To Restore External Stone-Work

From time to time we endeavour to offer our readers articles on the major undertakings of Public Works Departments overseas. The following article, together with illustrations and notes thereon, was kindly prepared for "PUBLIC WORKS OF SOUTH AFRICA" by Mr. J. H. Markham, F.R.I.B.A., a Senior Architect of His Majesty's Office of Works, London, and sent to us by courtesy of that Department.

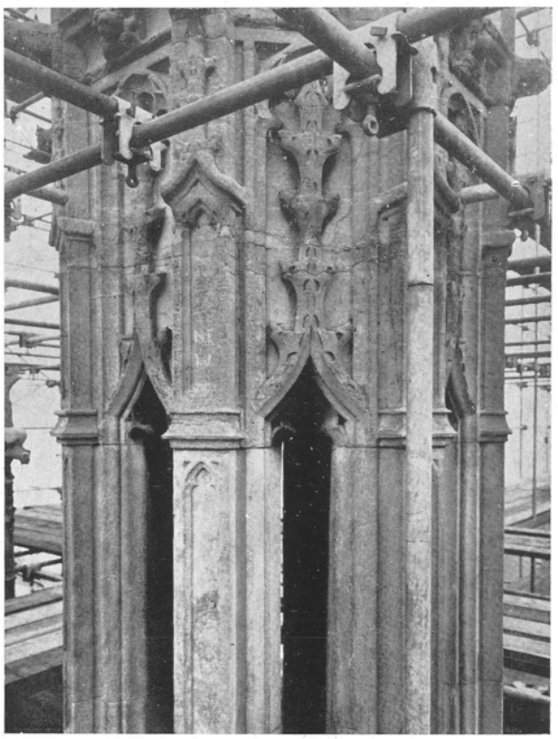
AMONG the many activities of His Majesty's Office of Works and Public Buildings is one relating to the upkeep and repair of buildings of national importance; and the work of restoring the external stonework, now being carried out at the Houses of Parliament, is of particular importance.

The dimensions of the building are approximately 950 feet long and 320 feet broad, with a central tower rising to a height of 250 feet above the central hall, flanked on the north by the Clock Tower, 320 feet high, and on the south by the Victoria Tower, 340 feet high. The average height of the walls is 80 feet, and the area of stonework is approximately 900,000 square feet.

The present building was erected on the site of the old Houses of Parliament, the greater part of which was destroyed by fire in 1834. In 1836 the design for the new building by Sir Charles Barry was selected in open competition. The first stone was laid in 1840, the greater part of the work was finished in 12 years, and the whole building completed in 20 years.

The building is in the perpendicular style of the Gothic period, and is richly decorated with a variety of ornament — floral, grotesque and heraldic. Some parts of the old buildings which were not destroyed by the fire — such as St. Stephen's Chapel, and the Cloisters — are incorporated in the present buildings. This in itself would suffice to indicate that a Gothic treatment was the most appropriate.

The upper part of St. Stephen's Chapel was removed at a later date on account of its dangerous condition.

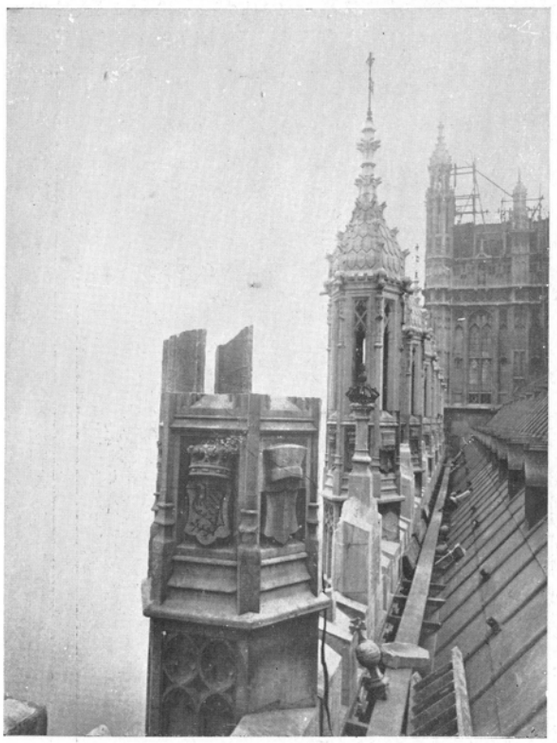


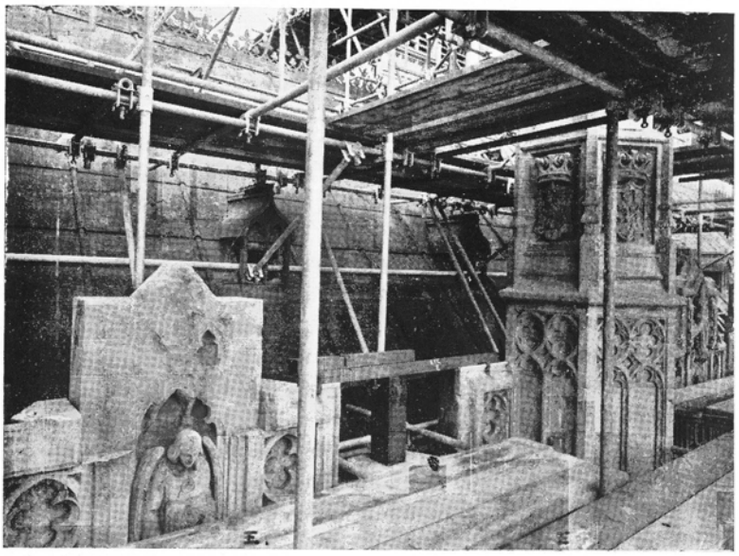
Part of a pinnacle showing the lines of laminated beds and vents in the stonework. In this case the beds are practically horizontal and therefore not actually dangerous.

Before the commencement of the work a committee was appointed to select the stone for the new building. They made extensive enquiries and visited numerous quarries and buildings and reported in favour of Bolsover Moor, a magnesian limestone from Derbyshire, but afterwards it was found impossible to obtain blocks of sufficient size. Finally a magnesian limestone from Anston, in Yorkshire, was chosen.

Except for a small quantity of Bolsover Moor used at the commencement, the whole building is faced externally with Anston. It is estimated that at least 750,000 cubic feet of stone was used.

Failure of Old Stone: OWING to the comparatively quick rate of building and the great quantity of stone required, it would seem that the care used in the selection of stone at the beginning was relaxed as the work went on. Although Anston stone has many excellent qualities, the inherent defects are hidden veins or vents that represent old sealed fractures and joint planes, probably caused by earth movement as a result of shrinkage. Exposure to atmospheric conditions, wind, rain and variations of temperature, causes the old sealed fractures to open, giving access to moisture with the risk of large portions of stone becoming detached and falling.





Above: *Face-bedded ornamental feature of which the projecting portion has fallen off on the plane of a laminated bed.*

Left: *A pinnacle from which the upper part has been removed as a precaution against falling. The tops of the broken corner mullions show the angle of the inclined vents which rendered the structure dangerous.*

This can be readily understood when the defects develop in free standing and overhanging features, for, upon examination, in nearly all such cases it was revealed that vents of a very dangerous character, known as sliding vents, had made their appearance.

The failure of the stonework, therefore, is due to geological joints and fractures in the stone, the effect of atmospheric impurities, and also to face bedding, *i.e.*, stone not placed on its natural bed. Face bedding, which has proved to be the cause of many of the stone defects, was freely used throughout the façades. It would appear to have been done in order to obviate the number of beds and joints which would otherwise be necessary, for Anston stone was not quarried in any great height. All heraldic panels, for example, are carved out of one stone, many being six feet square. In the new work each heraldic panel is composed of nine stones laid on their natural bed.

The stone used for the restoration is obtained from Clipsham, in Rutland. It is a shelly limestone, varying in colour from cream to golden brown, and weathers to the old-stone colour in a pleasing manner. Most of it comes from the Old Quarry and the Big Pit Quarry, and is delivered direct to the contractors' stone-yards in rough blocks. Here it is sawn and worked to the requisite details by the masons, who leave in square form all stone that is later to be carved into ornament by the stone-carvers. Stone-carving is usually done after the stone has been fixed in position, but some objects, such as independent heraldic beasts, are carved on the ground.

Clipsham stone blocks are taken from the quarry in irregular shapes and sizes. This regulates to some extent the height of the new stone courses to be used, but it has also been found impossible to obtain stone of the same heights as many of the existing courses to be replaced, in which case a rearrangement of the jointing becomes necessary.

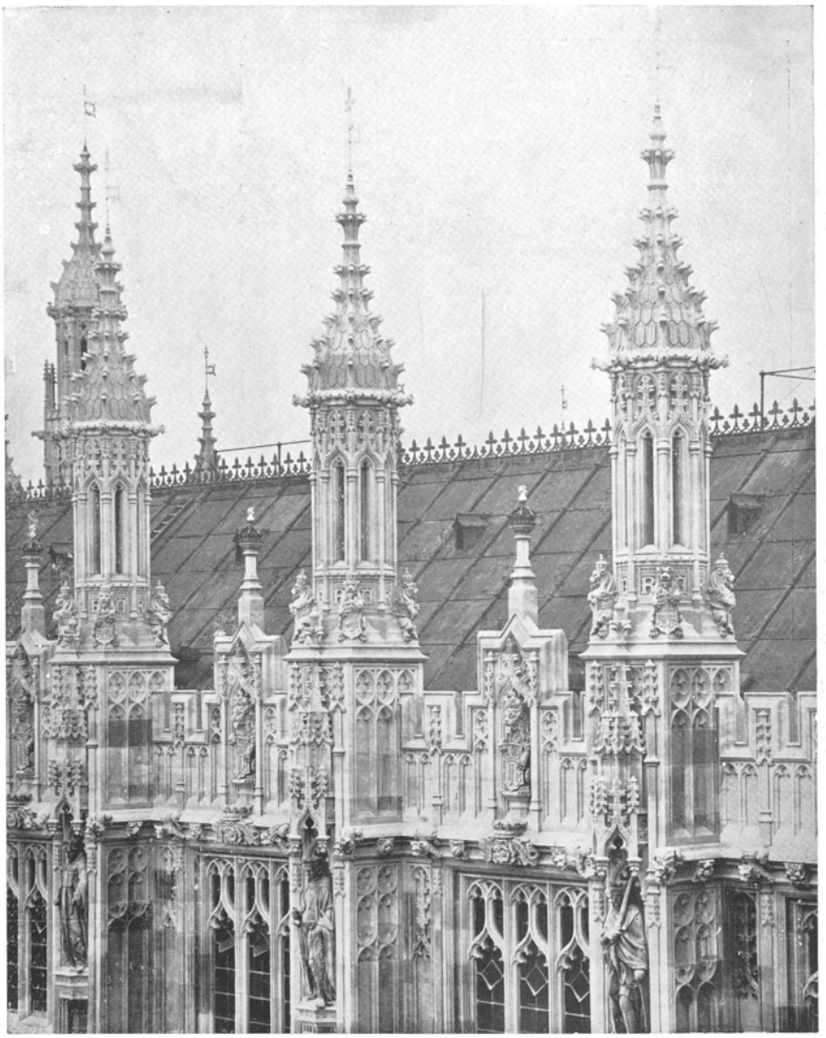
System of Restoration: IT is of first importance that careful particulars of the old stonework should be recorded in order to reproduce as exactly as possible the work in its original new condition. To this end a complete record is made of every carved piece of stone to be replaced, in order that the carvers can reproduce an exact copy of each ornament.

Restoration work is carried out systematically in sections. Each section is scaffolded with 2-inch diameter tubular steel in storey heights of 6 feet 6 inches. The walls are well washed with water under pressure to get rid of all surface grime, in preparation for the stonework examination. Close inspection is necessary before a decision is given to replace any of the stonework. It is specially confined to dealing with stone defects, for stone merely eroded by the weather is not removed without good reason. This is done under the supervision of Mr. John H. Markham, F.R.I.B.A., one of the Senior Architects of the Department.

All condemned stone is cut away by hand, and existing iron ties and cramps have, wherever possible, been removed and replaced by bronze metal.

The bedding and jointing material for the new stonework is a mixture of hydrated lime and Clipsham stone-dust, with the addition of a small percentage of portland cement.

Approximately 180,000 cubic feet of new stone have already been used.

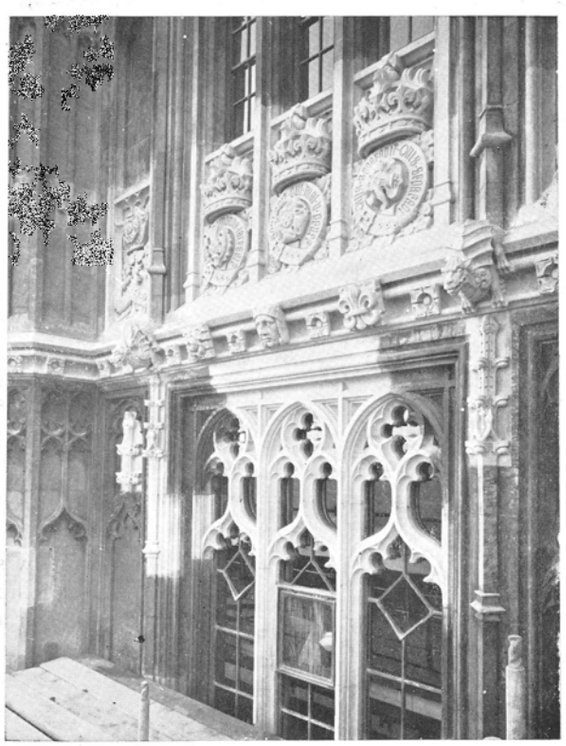


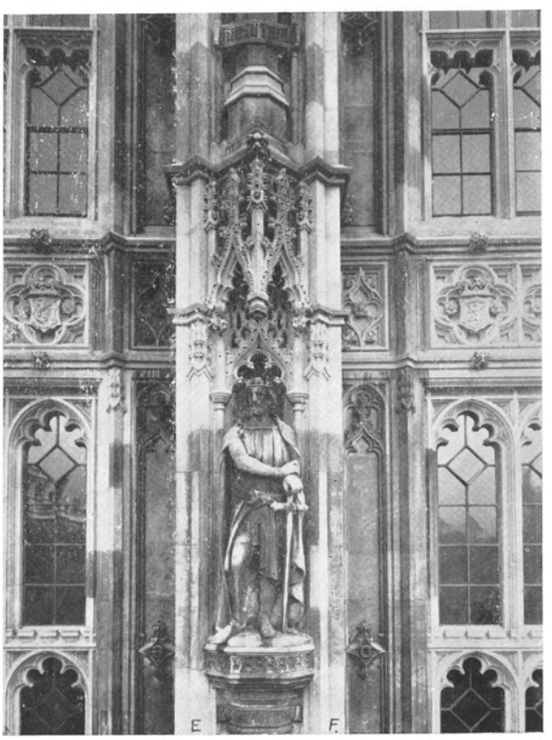
Top: *Parapet and pinnacles as reconstructed. The whole of the work above the cornice at the base of the parapet has been rebuilt in new stone; below that level patching, as necessary, has been carried out.*

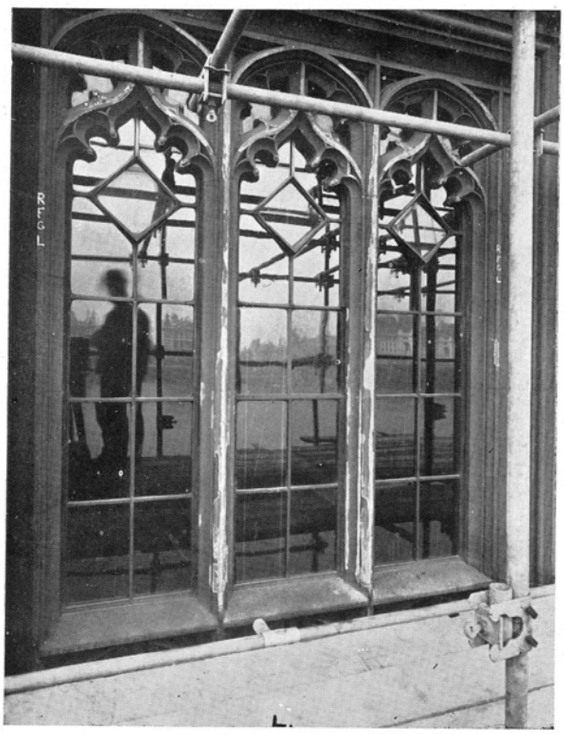
Bottom left: *A typical example of new stone introduced and old material left in position, showing crowns and emblems, ribands and mottoes of the three orders of knighthood. The rose of the House of York is on the extreme left-hand side.*

Bottom right: *Typical detail of part of the walling as restored. The projecting features have been rebuilt in new stone and patching has been applied to the wall surfaces.*

An interesting feature of this photograph is the pierced screen over the head of the statue. Behind this pierced screen is carved vaulting with small animal heads as corbels. Some of this elaborate work could hardly be appreciated from the ground.







A window: Note the surface decay on the face-bedded mullions.

The stonework restoration was commenced in 1928, the completion to be spread over a period of 15 years. Already 84% of the main façades and 24% of the Courtyard façades have been dealt with, in addition to the Central Tower and the Clock Tower.

Methods for the support of scaffolding have to be considered where the scaffold cannot be erected directly off the ground. At the extreme ends of the east front, platforms were formed on piles driven into the river-bed for this purpose. Attention had also to be given to the problem of support on the north and east sides of the Victoria Tower. As the adjacent roofs could not be used for bearing weight, a system of cantilever construction was adopted to carry the steel scaffolding.

A similar condition existed when dealing with the Clock Tower, and supporting gantries of timber and steel had to be provided.

Victoria Tower : THE Victoria Tower, the latest section of the work to be undertaken, attracts general interest, on account both of its unusual height and the network of scaffolding surrounding it, the outside dimensions of the scaffolding being 91 square feet and 340 feet high. The scaffolding is constructed throughout with tubular steel two inches in diameter; and some idea of the quantity of tubing used may be formed from the fact that, if the tubes were placed end to end, the total distance covered would equal nearly 60 miles; the total weight of the steel tubing alone amounts to approximately 600 tons.

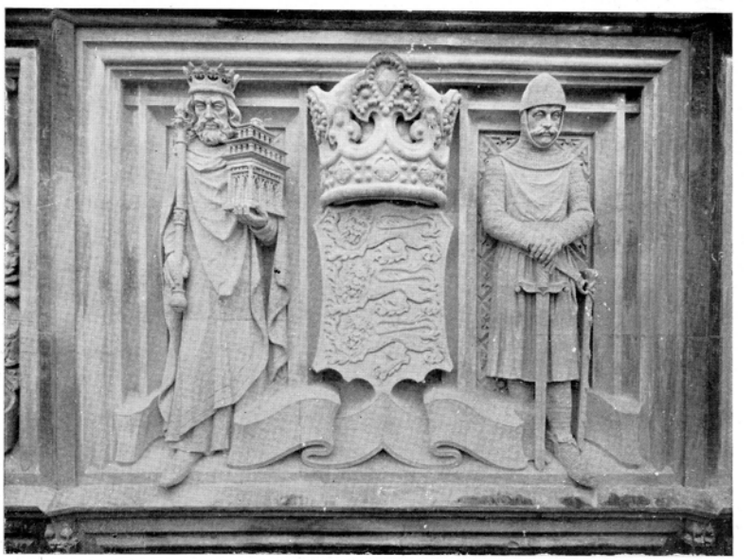
When, from time to time, the completed work is revealed, it can be seen that an immense amount of intricate work is involved in the stonework restoration. The building is not only rich in ornamental detail of great variety, but it will be observed that the decorative treatment includes heraldic panels commemorating English historical periods from early times. Free use has been made of the national devices, mottoes and emblems, and many panels bear expressions of loyalty to Queen Victoria, during whose reign the Houses of Parliament were built. Numerous canopied niches contain the statues of Kings and Queens of England, and of the Saints and the Patron Saints of Great Britain. Nearly 250 independent statues adorn the façades of the building, the greater number being life-size. They are regarded as monuments worthy of preservation, and, where any portion is in danger of becoming detached, it is secured with non-corrosive metal pins and cramps.

The north, east and south façades are divided into a series of bays throughout their lengths, and vertically into storeys by horizontal lines of carved work, each bay being dedicated to a King or Queen of England from the Anglo-Saxon period to the end of the Hanoverians. The upper line consists of historical reliefs, coats of arms, panels and heraldic supporting panels; the lower line bears a record of the dates of the reigns and the names of the Sovereigns of England. The Anglo-Saxon period is confined to the north and south façades, and the historical period from William I to Queen Victoria is recorded on the east façade or terrace front.

The façades facing New Palace Yard are also adorned with canopied niches containing the statues of the Kings and Queens of the last-named period.

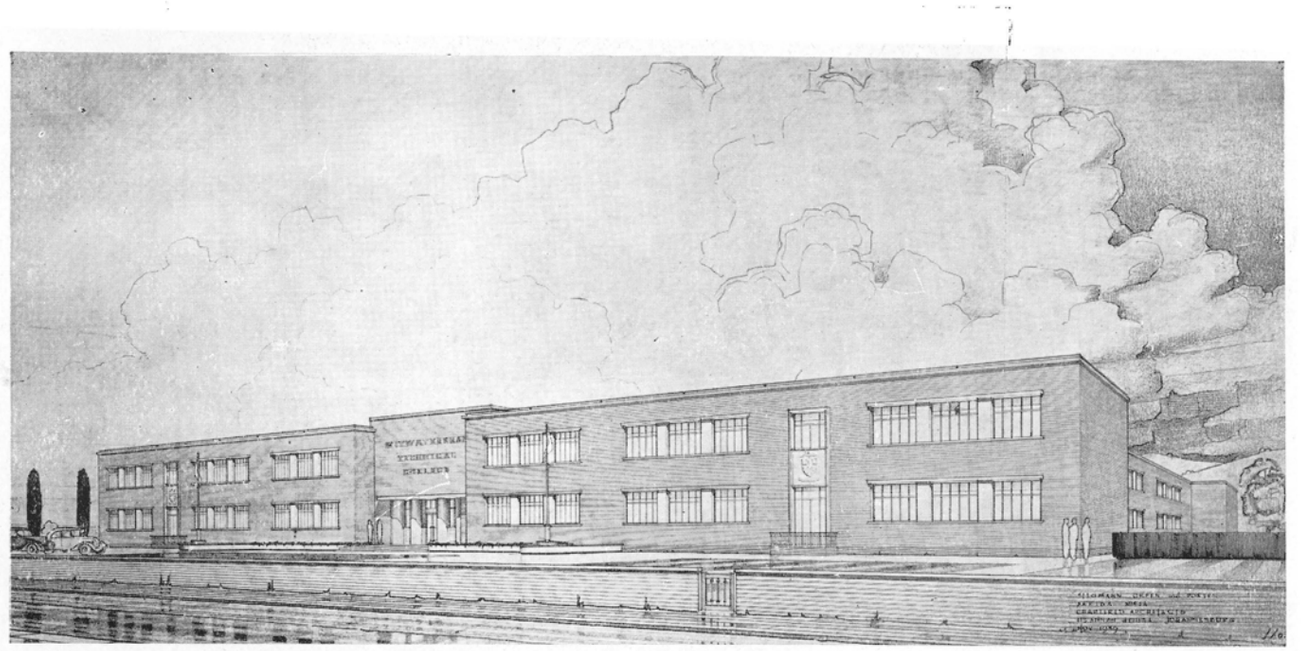
The west façade is arranged in alternate bays of oriel windows and square windows with balconies; the decorative treatment, in addition to many other carved pieces, consists of the national devices, mottoes and emblems.

COAT OF ARMS: EDWARD IV.



ANOTHER HERALDIC PANEL.

These two Heraldic Panels are on the river front. Both were originally carried out in one face-bedded slab. They have been renewed with stone in courses so as to maintain the material on its natural bed. The horizontal joints introduced can be just discerned.



THE NEW TECHNICAL COLLEGE *as it will finally appear. At present, only the central portion up to, but not including, the wing entrances, will be built.*

New Technical College for Klerksdorp

UNUSUAL CONSTRUCTIONAL FEATURES OF GYMNASIUM FLOOR.

CONSTRUCTION has already started at Klerksdorp on what is to be the nucleus of an important and well-equipped technical college. Besides representing a further step in the extraordinary growth of technical educational institutions following in the wake of industrial development along the Reefs of the Transvaal, the new building has a number of interesting features.

The structure now in the course of erection is to cost approximately £8,000. It is situated on a site about 14 acres in extent in Church Street, just beyond the new hospital on the main road to Western Reefs.

The building, as it is now being erected, will contain only four class-rooms, but it is so designed that any number of class-rooms up to 38 may be added when the development of mining activities in that region warrants such additions. In addition to these four class-rooms, there will be a small gymnasium, which, in the final plan, will form an entrance foyer to a large hall to serve the dual purpose of gymnasium and assembly hall. This hall will prove a useful asset to Klerksdorp, which at present lacks this facility. Provision is being made also for the future erection of workshops in which engineering and mining instruction will take place.

Construction:

THE building is of the reinforced frame type of construction, brick-filled and faced with iron-spot bricks. Special faggots are used to pass all stanchions and beams. Because of its temporary nature the roof over the gymnasium will be of corrugated iron. In other respects the building has the usual simple constructional features and finishes. Flooring is generally of Rhodesian teak-wood blocks. Separate electric water-heaters are to be installed to provide the changing rooms and lavatories with hot water.

Gymnasium Floor:

A FEATURE of unusual interest is the design of the gymnasium floor. The floor is resilient, its resiliance being obtained, not by means of springs. but by a slight overstressing of the joists and bearers, which are set up in a triple " deck " system.

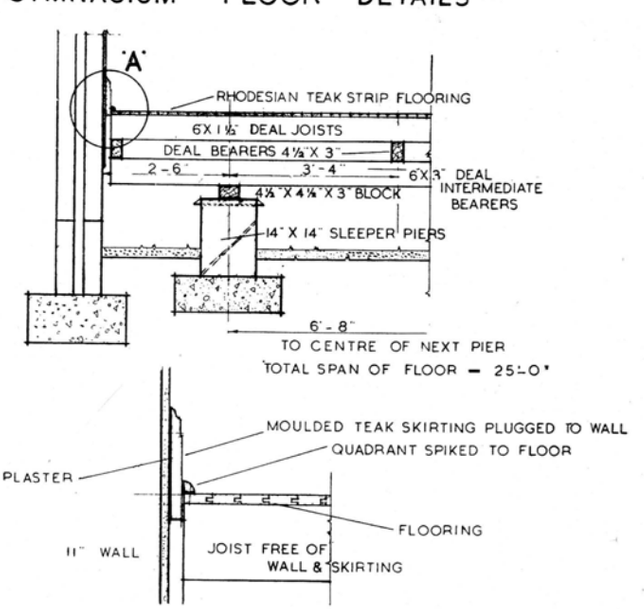
The floor is covered by Rhodesian teak strips $2\frac{1}{4}$ in. wide and $^{13}/_{16}$ in. thick, tongued and grooved. These strips are secretly nailed to joists 6 in. by $1\frac{1}{2}$ in., set at 15-in. centres as usual. To overcome the dead spots where the joists would normally be supported, a second system of bearers is put in at 6 ft. 8 in. centres, these bearers being $4\frac{1}{2}$ in. by 3 in. This arrangement slightly overstresses the first system or " deck " of joists, but it would result in dead spots at all the points where the bearers were supported. A third system or " deck " of joists is included therefore, consisting of timbers 6 in. by 3 in., set at 5 ft. centres, these joists being supported by piers at 6 ft. 8 in. centres.

It will be observed from the diagram reproduced here that each system is supported on the lower system at points midway between the supports of that lower system, thereby gaining full advantage of the bending moment. It will be seen also that the bottom system of joists is not supported at the extreme ends, where they take the form of cantilevers. The perimeter of the floor, therefore, is as resilient as the centre.

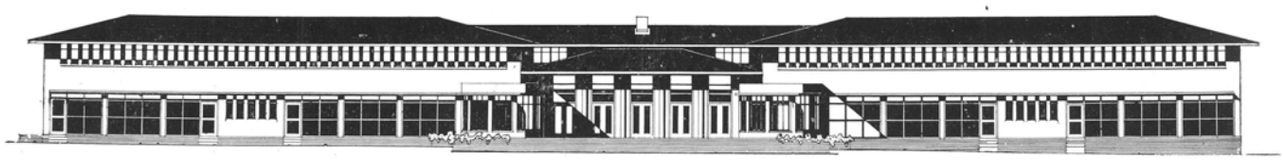
Experience has proved that this type of floor not only has a high degree of noiseless resilience — it does not creak — but it is also sufficiently stable to be comfortable for ordinary walking. The springing is even, and ideal for such purposes as gymnastics and dancing.

The architects are Messrs. Stegmann, Orpen and Porter.

GYMNASIUM FLOOR DETAILS



DETAIL AT 'A'



NORTH ELEVATION.

New School Hostel at Barberton

An Interesting Example of Dormitory Design

THE new school hostel at Barberton to accommodate boys and girls between the ages of 7 and 15 years is now nearing completion, at a contract price of £15,873. Though not a large building, the design offers several interesting and unorthodox features, and is a good example of a fine structure achieved at a reasonable price. The building is being erected by the Transvaal Provincial Administration, and the architect is Mr. J. Lockwood-Hall.

OUTSTANDING FEATURES OF DESIGN:

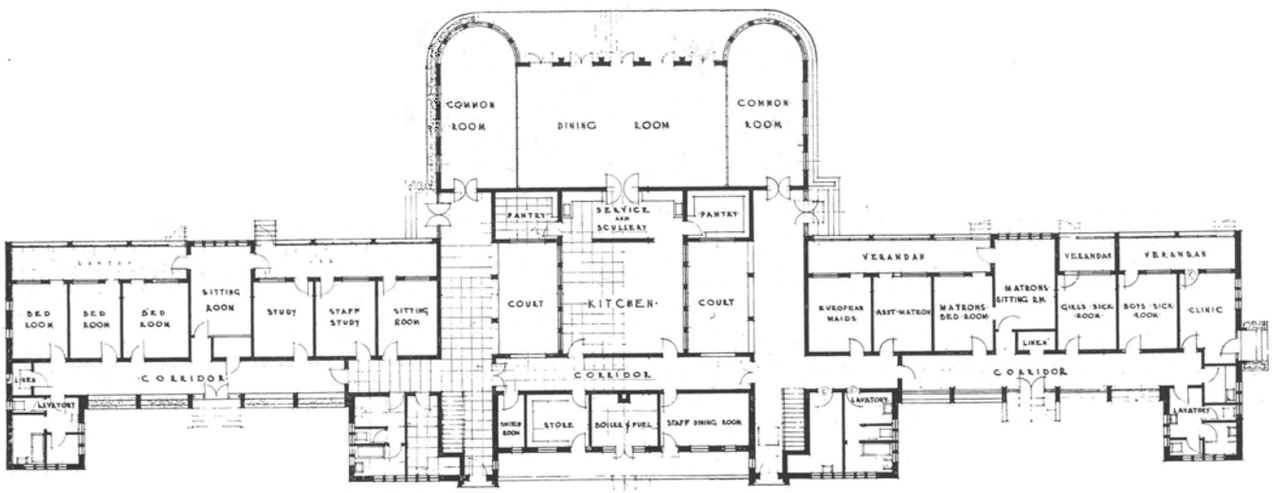
FROM the design point of view the most interesting feature is to be found in the arrangement of dormitories on the first floor. The dormitories are ranged on the north side of both wings, and are divided into a single unit of 10 beds, three units of 4 beds and one unit of 6 beds, with a prefects' room for two beds in each wing. Each of these dormitories opens out on to a dressing-corridor, the medium separating the dormitories from the corridor being a 7-ft. high partition wall. The dressing-corridor is 8 ft. 6 in. wide.

The virtue of this arrangement is that it enables each dormitory to have adequate adjacent dressing space without the cost of providing separate dressing-rooms or one large communal dressing-room, a provision which would be attended by considerable inconvenience. The arrangement also avoids confusion and untidiness in the dormitories.

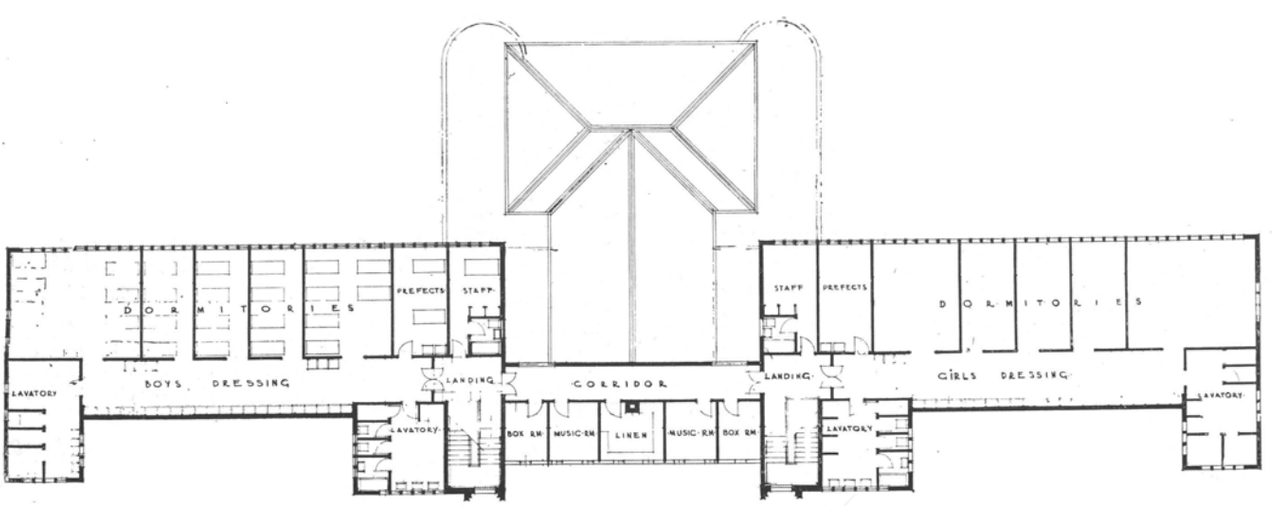
The south wall of the corridor in each wing is occupied by steel lockers comprising hanging spaces, drawers and mirrors. The space above the lockers is taken up by continuous clerestory lights. The use of only a partition wall between each dormitory and the corridor is advantageous in that it saves cost, allows adequate cross-lighting and ventilation, and avoids the use of doors, which in a hostel are sometimes detrimental to full supervision of the dormitories. On the north side the dormitories are lit by continuous windows in a 90-foot span supported on mullions.

To each wing there are two bathroom and lavatory blocks projecting out from the south façade, a planning feature useful in securing maximum ventilation and lighting for such units.

An attractive feature of the ground-floor plan is the siting of the dining-room and two adjacent common-rooms in a north-projecting block. The dining-room has five double-swing glass-panelled doors on the north side opening out on to a 10-ft. wide patio overlooking the campus. The two common-rooms have circular glazed ends, and are separated from the dining-room by folding doors, so that the three units may be converted into a single large hall for functions when desired.



GROUND FLOOR.



FIRST FLOOR.

The dining-room block together with the centrally situated kitchen, scullery and pantry form a single-storey unit under a pitched corrugated iron roof with wide overhanging eaves with batten soffit. The dining-room ceiling height is 14 feet, while that of the adjacent common-rooms is 10 feet, formed by a concrete slab roof. This arrangement provides a central emphasis for the north elevation.

ACCOMMODATION:

Ground Floor. — On the left wing the ground floor contains three bedrooms, two studies, a staff sitting-room 12 ft. by 14 ft. 6 in., and one large sitting-room 12 ft. by 18 ft., approximately. This latter sitting-room is set off the common axis so that access might be had through side doors to the 6 ft. 6 in.-wide gauze-enclosed verandah on the north side.

The right wing contains the matron's suite, accommodation for the assistant matron, and a dormitory for two European maids. There is also a clinic 11 ft. wide by 14 ft. 6 in. deep. Adjoining the clinic are two sick-rooms, one for boys and the other for girls. The sick-rooms and clinic have private verandahs.

The two wings are separated by a corridor serving the kitchen, the domestic staff dining-room, boiler and fuel-room and store-room.

The kitchen is 24 ft. wide by 21 ft. 9 in. deep, with a scullery 9 ft. 4½ in. wide adjoining, the scullery being separated by a low partition wall. Both kitchen and scullery walls are finished in white glazed tiles up to door height. A service panel opens out from the scullery to the dining-room. It will be observed that, although centrally placed, both kitchen and scullery receive adequate cross-lighting and ventilation from the open court flanking each side. The dining-room is 24 ft. wide by 41 ft. 9 in. long, each of the flanking common-rooms being 15 ft. wide and 31 ft. 6 in. deep.

First Floor. — This floor has already been described in more or less complete detail. Briefly, there are to each wing five dormitories to accommodate 28 scholars, one dormitory for two prefects and one staff dormitory with separate bathroom and lavatory accommodation.

CONSTRUCTION:

The building is entirely of brick construction, brick force being used even over the 90-ft. span to the north elevation windows. There are no concrete lintels. In order to obviate the danger of cracking, the use of concrete was avoided, except for the surface bed, the foundations and the first floor, which is a reinforced concrete slab. Windows throughout are steel, fitted with mosquito-gauze screens. All verandahs, similarly, are screened.

The floors are generally of extra-heavy 5-ply mastipave, except in the dining-room and common-rooms, where ⅞-in. Rhodesian teak strip flooring is being used in 3¼-in. widths. Bathroom and lavatory blocks have grano floors as well as the kitchen and scullery block.

The roof is of corrugated iron insulated with 6-ply "Sisalkraft" sarking. Internal walls will be painted in pastel shades, and all flush doors will be painted. External walls will be cement plastered, and set off by dark blue foundation bricks.

SITE:

The site of the school hostel is on a hill sloping down northwards. It is 390 feet deep, and 400 feet wide at the south end, the east boundary converging to form a width of 315 feet at the north side. The building is placed well back, leaving ample room for a semicircular campus of 145 feet radius in front, as well as space for two further blocks when extension is desired.

* * *

The foundation stones were laid by His Honour the Administrator of the Transvaal, General J. J. Pienaar, on October 23 last. It is expected that the building will be complete by the end of April this year. The contractor was J. C. Greger, of Barberton, and the quantity surveyor J. W. Cowling & Son.

Concrete Flooring

The following Note, issued by the Director of Building Research, Information Bureau of the Building Research Station, Britain, is written from the point of view of building and climatic conditions in the British Isles. Readers must use their own judgment in applying any of the recommendations made, or the suggestions offered, to conditions in South Africa. It is a summary of available knowledge — the treatment is not exhaustive. It is presented in the hope that it may be found useful as a convenient resumé of existing information.

SINCE 1935, eighty-seven enquiries have been received at the Building Research Station on difficulties experienced with concrete floors, indicating that the subject is of sufficient importance to justify the issue of a note. A comprehensive investigation of concrete floors has not yet been made in this country, though certain researches into the effect of hardeners, and on the bonding of new concrete to old, throw light upon some aspects of the problem. In America the subject has been studied more directly and comprehensively, and in the present note advantage is taken of this experimental work in its bearing on the problems which arise in practice.

Analysis of the enquiries received reveals that the defects complained of can be divided under several heads:—

1.	Lifting, warping and cracking	25
2.	Dusting	32
3.	Slipperiness	9
4.	A variety of other defects such as general disintegration, sweating, etc.	21

It should be observed that the above summary excludes a considerable group of enquiries dealing with injuries from various forms of chemical attack, such as by vegetable oils, sugar and sugary substances and dairy products, and of which no account will be taken in the present note. And of the troubles taken for the purposes of the above analysis, and which may be described broadly as being of mechanical or physical origin, there will be discussed only those of lifting, warping or cracking, and dusting, which the analysis shows to be the principal problem with concrete floors.

Lifting, Warping and Cracking.

The fundamental cause of lifting, warping and cracking is the difference in shrinkage properties of the surfacing and the base to which it is applied. Concrete wearing surfaces are invariably richer than the base, the usual specification being 2 parts of cement to 5 parts of granite chippings.[1] The usual mix for structural concrete on the other hand is 1 part of cement to 2 parts of sand and 3 or 4 of coarse aggregate. Concrete shrinks as it dries, and experiment shows that very rich mixes — and a surfacing must be described as such — have higher shrinkage than lean, so that there is always some tendency for differential movement between a granite topping and the base.

If a topping is applied to structural concrete which has hardened and dried, there is then a marked differential shrinkage, for the whole of the shrinkage of the topping has to take place with respect to a base which has reached approximately its final dimensions. A further factor which enters is that the shrinkage of the structural concrete may be restrained by reinforcement when this is used, which also tends to increase the differential movement between topping and base. If a concrete floor surfacing is applied to the structural concrete before the latter has taken its final set there is little risk of lifting. But this hardly provides a solution to the problem: the immediate application of a surfacing involves serious interference with the usual course of building operations, and it is necessary to arrive at a specification which will ensure reasonably satisfactory results in a structure which is some weeks or months old. Nevertheless, where arrangements can be made for the topping to follow the structural concrete immediately, a better result, from the point of view of adhesion, may be expected.

1. *Adhesion.*

The shrinkage of a concrete topping tends to cause a parting at the plane of contact between the surfacing and the structural concrete. This tendency can be minimised by:—

(*a*) Improving the adhesion of the two concretes.
(*b*) Reducing the shrinkage of the topping.

Examination of cases of cracking and lifting in floors indicates that poor adhesion is the chief cause of trouble and it is in this direction that improvement is principally to be sought, but beneficial modifications could also be made in regard to (*b*) above.

The strength of adhesion between concretes of different compositions has been studied by N. Davey and the results of numerous experiments were given in a Building Research Special Report, "Construction Joints in Concrete: Bonding New Concrete to Old."[2] Methods have been developed whereby a new concrete can be bonded to old concrete of similar composition so effectively that the joint is as strong as the concrete on either side. The best procedure involves:—

(1) Chipping and wire-brushing the old surface.
(2) Moistening the concrete.
(3) Application of a grout.
(4) Application first of a rich, then of a normal mix of cement mortar.

In this way a gradation of the materials in the joint is effected and differential shrinkage is reduced. This procedure is too elaborate for use in flooring work, but one of its most important features, namely, the use of a neat cement grout is already widely adopted.

One of the facts which emerged is that it is difficult to secure good adhesion of a rich granite concrete to

ordinary ballast concrete when the latter is mature. Test pieces of 1:2:3 gravel concrete were prepared, and 2:5 granite concrete was immediately joined on. Other specimens of ballast concrete were kept for 28 days before the granite concrete was added, but then the surface of the old concrete was grouted with neat cement. Comparative tests were made on ballast concrete joined to concrete of the same composition. The following results were obtained:—

	STRENGTH OF ADHESION *(Expressed as percentages of best joint strength).*
Gravel concrete (1:2:3) joined to fresh gravel concrete	98 per cent.
Gravel concrete joined to old gravel concrete	83 ,, ,,
Granite concrete (2:5) joined to fresh gravel concrete	100 ,, ,,[3]
Granite concrete joined to old gravel concrete	40 ,, ,,

The figures show that the bond strength of granite concrete applied to matured ballast concrete is much less than the best attainable, but it is probable that, if a value approaching this bond strength were obtained in practice, lifting of surfacings would be rare. Unfortunately there are other important influences which still further impair the rather poor bond. Amongst these may be mentioned:—

Laitance. — Structural concrete in floors, especially if placed rather wet, often has a layer, 1/16 in. – 1/8 in. thick, of laitance, consisting of cement and excess water, silt from the aggregate and other impurities in the concrete. The laitance layer can reduce bond strength by one half.

Surface Contaminations. — Concrete floors which are not immediately surfaced quickly become coated with a thin layer of dirt and clay carried in by foot traffic and frequently with other impurities such as plaster, oil, etc. A surface so contaminated may appear quite firm, when dry, but is quite unsuitable to receive a granite concrete topping. It must be emphasized that the application of a grout to such a surface does little to improve the conditions, for though the topping and grout may adhere perfectly the grout will be pulled clean away from the loose surface beneath, as has been found in a number of cases investigated.

Proper preparation of a concrete base to receive a granite concrete surfacing involves cleaning the base so thoroughly that a hard, strong, but rough, surface is exposed which is capable of restraining the shrinkage of the topping. A Committee of the American Concrete Institute who recently reported the results of some very comprehensive investigations into concrete flooring[4] gave a schedule of labour costs for laying 1,000 sq. ft. of surfacing, as follows:—

Preparing the base (roughening and cleaning)—	
32 man-hours, common labour	$20·80
Laying two coats and finishing—	
12 man-hours, skilled labour 27 ,, ,, common ,,	$32·55
Curing—	
3 man-hours, common labour	$1·95
	$55·30

or nearly 40 per cent. labour costs on preparation of the base. The fact that this part of the work often receives but perfunctory attention is undoubtedly responsible for a great deal of trouble.

2. *Other Factors Influencing Lifting.*

The attempt to reduce shrinkage of concrete topping must be made with caution, but improvements are certainly possible, in the following directions:—

(a) *Richness of Mix.* — The standard mix for floors is undoubtedly unduly rich. Nevertheless, if the aggregate is not clean and well graded, it would be unwise to reduce the cement content, otherwise the cement paste will be weak and the floor will wear badly. If, on the other hand, the aggregate is thoroughly clean and well graded, there is no reason why the aggregate content should not be increased to 1:3. Granite chippings which are clean but deficient in finer grades could be improved by the addition of *clean coarse* sand in the following proportions:—

1 cement
1 sand
2 granite.

A harsh grade of chippings, together with clean sand, would, it is thought, lead to better results than a rather finely crushed aggregate containing an excess of dust. The results of the American tests favour the use of rather coarse chippings, 3/8 in. – 1/8 in., together with sand, 1/8 in. down, which contains not more than 15 per cent. passing a 50 sieve. These aggregates are combined in the proportions:

1 cement
1⅓ sand
2 coarse aggregate.

A specification framed on these general lines deserves careful consideration.

(b) *Water Content.* — Shrinkage will be increased by the use of excessive amounts of mixing water. Flooring mixes should therefore be laid as stiff as practicable. This point is also referred to under " Dusting " below, this being a defect which also is much influenced by water content.

DUSTING.

It is not uncommonly found that when concrete floors are first subjected to traffic, a considerable amount of dust is formed by the rapid wearing of the surface. This effect can be extremely objectionable in factories where delicate machinery is used or where foodstuffs or photographic materials are handled. Examination of a floor which is dusting reveals the presence of a thin

surface layer of soft material, overlying the hard granite concrete beneath.

The formation of this layer is in part due to the nature of the aggregate used, in part due to workmanship.

In a concrete mix there is always a tendency for the large aggregate to sink, while water, fine cement particles, clayey matter in sand, or granite dust rise to the surface. The trowelling of a concrete floor merely smoothes and consolidates this laitance layer which then forms the surface of the floor. As it consists of fine cement particles, clay and dust and contains no hard aggregate, its poor wearing properties are not surprising. The appearance of a floor in which considerable laitance has formed, but which has been skilfully trowelled is generally deceptively good, but if the traffic is heavy the surface film quickly wears away until the hard, strong granite concrete, which is capable of resisting wear, is exposed.

An understanding of the nature of the dusting layer at once indicates the precautions which must be taken to avoid trouble. Several factors which have been enumerated as important from the point of view of cracking and loss of adhesion are important in this connection also.

(a) *Water Content.* — Laitance is encouraged by the use of excessively wet mixes. Concrete for flooring should be laid as stiff as possible consistent with (1) good adhesion to the base and (2) satisfactory consolidation. Mixes of sloppy consistence, trowelled while still very soft, are particularly liable to dust.

(b) *Aggregate.* — The aggregate used should be free from dust and clayey matter, which are constituents of laitance.

With the object of producing a very smooth finish — or in order to speed up the finishing of a floor which has been laid very wet — the practice is sometimes adopted of sprinkling the surface with neat cement. This causes dusting and is therefore to be deprecated.

The stage at which a floor is trowelled seems to influence the liability to dusting. Evidently it is desirable that there should be as little trowelling as possible, consistent with the production of a smooth surface, for trowelling encourages the formation of a laitance layer. The coarse granite fragments constitute the essential wear-resisting element in the floor and these should be kept as close to the surface as possible. The American Committee, whose work has already been referred to, suggest the following procedure:— The floor having been laid as stiff as possible, the surface is immediately floated to a compact and smooth surface. It is then allowed to stand for not less than 30 to 45 minutes. Trowelling is not begun until pressure with the finger ceases to make any indentation. This is essentially similar to the practice adopted by experienced floor layers in this country with the object of obtaining the required smooth finish without encouraging laitance. (Some modification of the procedure will be required where heavy dressings of carborundum have to be incorporated, or where a surface hardened by the incorporation of iron particles is applied. The above suggestions relate to the non-surfaced type of granite concrete floor.)

As soon as the surface is hard enough it should be covered, either by waterproof paper, or by damp sand or sawdust to prevent evaporation. Curing in this way for from four to seven days should not only minimize the risk of dusting, but also ensure that the full thickness of the topping attains a good degree of strength before it is subjected to traffic.

Surface Hardening Treatments.

It is now quite common to apply a surface hardening treatment to floors either to stop dusting which is already occurring, or initially, as a general precaution, to improve the immediate abrasion-resistance of the floor.

Two classes of substances are used:—

(1) Water solutions of silicates, silicofluorides, etc.
(2) Oils or solutions of oils in spirit.

Of the former class sodium silicate (waterglass) is the best known. A special grade is sold for floor hardening and it is the usual practice to make several applications of a weak solution, with intervals for drying. This treatment is generally effective. Silicofluorides are also used. Zinc sulphate and aluminium sulphate also have a hardening effect. The latter has been found, in laboratory tests, to be particularly powerful in its effect, but the Station has no experience of its use in practice.

The second class of treatments consists in the application of drying oils, of the kind used as paint media, either in the form of the plain oil, or mixed with an equal part of turpentine or white spirit. The thinned oil will have the greater penetration power. Linseed oil, either raw or boiled, and tung oil (china-wood oil), have all been found effective.

The solutions required for floor hardening can either be prepared on the job using (*a*) the appropriate grade of sodium silicate, diluted with water, or (*b*) oil, plain or thinned, or they may be purchased ready for use since there are a number of proprietary preparations in which substances in one of the two classes mentioned form the essential constituent and these may be found convenient in practice as avoiding the necessity of making up solutions on the site.

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[1] The term granite is not used here in its strict geological meaning, but covers any hard aggregate suitable for flooring, such as quartzite.

[2] The practical conclusions from the research mentioned are given in succinct form in Bulletin No. 9, "Bonding New Concrete to Old," price 3d. net. H.M. Stationery Office.

[3] The best joint strength is about half that of a specimen of monolithic ballast concrete.

[4] Journal of the American Concrete Institute, Volume 10 (No. 1), page 21 (September, 1938).

Tenders Invited

THE following are particulars of the more important tenders which have been invited, up to the time of going to press, by Government Departments and Provincial Administrations. In each case the date by which tenders must be submitted, and the office to which application should be made, are given.

AIR-CONDITIONING AND CENTRAL HEATING.

Central heating installation at Automatic Exchange and Mining Commissioner's Office, Heidelberg: supply, delivery and erection (P.W.D. tender 537): P.W.D., Pretoria (Room 531, 'phone 5477). **4th April.**

Central heating installation at Pretoria Magistrates' Courts: supply, delivery and erection (P.W.D. tender 560): Particulars as above. **9th May.**

Central heating installation at Grootfontein Wool Research Laboratory, Middelburg, C.P. (P.W.D. tender 569): P.W.D., Pretoria (Room 531, 'phone 5477). **16th May.**

Air-conditioning plant for Grootfontein Wool Research Laboratory, Middelburg, C.P.: supply, delivery and erection (P.W.D. tender 559): Particulars as above. **9th May.**

Air-conditioning plant for Rosebank Automatic Telephone Exchange: supply, delivery and erection (P.W.D. tender 576): Particulars as above. **23rd May.**

BRIDGES AND MATERIALS.

Bridgework for S.A.R. & H. Administration (tender 2557): Railway Stores at Salt River, Uitenhage, East London, Durban, Bloemfontein, Pretoria; and Chief Stores Superintendent, S.A.R. & H. Headquarters Offices, Johannesburg. **8th April.**

BUILDINGS AND ALTERATIONS, ETC.

Additions to school at Hennenman, O.F.S. (P.W.D. tender 567): P.W.D., Pretoria (Room 531, 'phone 5477), and District Representative, P.W.D., Bloemfontein. **2nd April.**

Alterations and additions to Government Garages, Pretoria (P.W.D. tender 566): P.W.D., Pretoria (Room 531, 'phone 5477). **4th April.**

Additions to Primary School, Bethlehem, O.F.S., for conversion into Girls' School (P.W.D. tender 572): P.W.D., Pretoria (Room 531, 'phone 5477), and District Representative, P.W.D., Bloemfontein. **9th April.**

Additions to Wellington Boys' High School, C.P.: Secretary, School Board, Wellington, and Messrs. Forsyth & Parker, Westminster House, Longmarket Street, Cape Town. **9th April.**

Additions to Bellville Primary School, C.P.: Messrs. Jones & Day, 6, Church Square, Cape Town. **9th April.**

Additional class-room, Secondary School, Great Brak River: Messrs. Simpson & Bridgman, chartered architects, Oudtshoorn. **9th April.**

Quartermaster's stores at S.A. Military College, Voortrekkerhoogte (P.W.D. tender 571): P.W.D., Pretoria (Room 531, 'phone 5477). **11th April.**

Quarters for Gaoler, Ficksburg (P.W.D. tender 573): P.W.D., Pretoria (Room 531, 'phone 5477), and District Representative, P.W.D., Bloemfontein. **11th April.**

CHEMICALS, LABORATORY EQUIPMENT, ETC.

Contact thermometers and relays for Low-Temperature Research Laboratory, Cape Town (tender S.O. 745): Union Tender and Supplies Board, 271 Visagie Street (P.O. Box 371, 'phone 3121), Pretoria. **9th May.**

Glass specimen jars for Onderstepoort Laboratory (tender S.O. 755): Particulars as above. **18th April.**

Chemicals for Onderstepoort Laboratory (tender S.O. 776): Particulars as above. **25th April.**

Giemsa's solution for Romanowsky staining for Onderstepoort Laboratory (tender S.O. 773): Particulars as above. **25th April.**

Chemicals and apparatus for Pasture Research Stations, Division of Soil and Veld Conservation (tender S.O. 793): Particulars as above). **2nd May.**

Chemicals and apparatus for Division of Chemical Services, Pretoria (tender S.O. 783): Particulars as above. **30th May.**

Hypodermic syringes for Onderstepoort Laboratory (tender S.O. 802): Particulars as above. **23rd May.**

COOKING EQUIPMENT, ETC.

Steam boiling pans (cooking pots) for Public Works Department (P.W.D. tender S. 16): P.W.D., Pretoria (Room 546, 'phone 3504). **2nd May.**

Electric cooking apparatus for Prime Minister's Residence, Pretoria: supply and delivery (P.W.D. tender 574): Particulars as above. **4th April.**

ELECTRICAL EQUIPMENT.

Magneto bells and switches, supply of (P.O. tender 845): District Stores Superintendents, Johannesburg, Cape Town, Port Elizabeth, East London, Durban, Bloemfontein; Divisional Controller, P.O. Pietermaritzburg; Controller of P.O. Stores, Room 77, G.P.O. Annexe, Pretoria. **11th April.**

Accumulators (P.O. tender 850): Particulars as above. **2nd May.**

Alternator for State Alluvial Diggings, Alexander Bay (tender S.O. 786): Union Tender and Supplies Board, 271 Visagie Street (P.O. Box 371, 'phone 3121), Pretoria. **2nd May.**

FURINTURE AND FITTINGS.

Furniture for Mental Hospital, Pretoria (P.W.D. tender 575): P.W.D., Pretoria (Room 531, 'phone 5477). **4th April.**

LAUNDRY EQUIPMENT.

Vertical steam boiler and feed pumps for Grahamstown Mental Hospital Laundry: supply and delivery (P.W.D. tender 579): P.W.D., Pretoria (Room 531, 'phone 5477). **23rd May.**

REFRIGERATING PLANT.

Refrigerating plant for Western Province Fruit Research Laboratory, Stellenbosch: supply, delivery and erection (P.W.D. tender 539): P.W.D., Pretoria (Room 531, 'phone 5477). **4th April.**

ROADS AND ROAD-MAKING EQUIPMENT.

Rock crusher and tractor for Pongola Settlement (tender S.O. 789): Union Tender and Supplies Board, 271 Visagie Street (P.O. Box 371, 'phone 3121), Pretoria. **2nd May.**

Mechanical shovels for Tvl. Prov. Admin. (tender 11/1940): Superintendent of Provincial Stores, P.O. Box 857, Pretoria. **3rd April.**

Bituminous road-binder, approx. 620,000 galls. (Tvl. Prov. tender 15/1940): Superintendent of Provincial Stores, P.O. Box 857, Pretoria. **3rd April.**

Plant for construction of National Roads, Cape Province, and workshop equipment (tender F. 26/1940): Particulars in Cape Official Gazette, 1st March. **26th April.**

MISCELLANEOUS.

Machinery for State Alluvial Diggings, Alexander Bay (tender S.O. 747): Union Tender and Supplies Board, 271 Visagie Street (P.O. Box 371, 'phone 3121), Pretoria. **11th April.**

Hydraulic lifts (for motor cars, etc.) (S.A. Police Indent 244): Quartermaster, S.A. Police (P.O. Box 449), 149 Koch Street, Pretoria. **18th April.**

15-ton level luffing electric portal travelling wharf cranes (2) for S.A.R. & H. Administration (tender 2586): Railway Stores at Salt River, Uitenhage, East London, Durban, Bloemfontein, Pretoria; and Chief Stores Superintendent, S.A.R. & H. Headquarters Offices, Johannesburg. **6th May.**

Structural steelwork, etc., for S.A.R. & H. Administration (tender 2556): Particulars as above. **6th May.**

Bar steel for S.A.R. & H. Administration (tender 2615): Particulars as above. **13th May.**

Level luffing electric portal travelling wharf cranes for S.A.R. & H. Administration (tender 2587): Particulars as above. **5th May.**

N.G. locomotives, class NG/G. 16, for S.A.R. & H. Administration (tender 2549): Particulars as above. **13th May.**

Lucerne press for Olyvenhoutsdrift Settlement (tender S.O. 808): Union Tender and Supplies Board, 271, Visagie Street (P.O. Box 371, 'phone 3121), Pretoria. **4th April.**

Tubular gates for Vaal-Hartz Settlement (tender S.O. 805): Particulars as above. **4th April.**

Fencing material for Department of Native Affairs (tender S.O. 797): Particulars as above. **4th April.**

Fencing material for Vaal-Hartz Settlement (tender S.O. 799): Particulars as above. **4th April.**

Concrete mixer, garden tools and building material for Krom River Settlement, District Humansdorp (tender S.O. 800): Particulars as above. **4th April.**

Baling wire for Olifants River Settlement, near Upington (tender S.O. 801): Particulars as above. **4th April.**

Angle iron, flat mild steel, steel plates, rivets (Irrigation tender 489): Controller of Stores, Irrigation Department (P.O. Box 277), 474 Carl Street, Pretoria. **4th April.**

Electric vacuum cleaners and floor polishers for Government Buildings at Bloemfontein and Kimberley (P.W.D. tender 577): P.W.D., Pretoria (Room 531, 'phone 5477). **23rd May.**

Tenders Accepted

THE following are particulars of some of the contracts which have been awarded by Government Departments and Provincial Administrations. The name of the successful tenderer is given in each case, and, wherever practicable, the contract price.

AIR-CONDITIONING AND CENTRAL HEATING.

Central heating, East Wing Additions, Central Government Offices, Pretoria (P.W.D. tender 443): A. E. Barker, Johannesburg. £2,768.

Central heating installation for female V.D. block, Rietfontein (P.W.D. tender 422): F. A. Sharman (Pty.), Ltd., Johannesburg. £339.

BUILDINGS AND ALTERATIONS, ETC.

Offices for Union Government, Lourenço Marques (P.W.D. tender 441): M. C. Ribeiro Avenida, Lourenço Marques. £33,500.

Admission Block at Mental Hospital, Pietermaritzburg (P.W.D. tender 497): F. Brierley, Durban. £25,947 6s. 10d.

Hutments for Artillery at Potchefstroom — Contract No. 2 (P.W.D. tender 449): Anderson Andrew (Pty.), Ltd., Johannesburg. £14,995.

Hutments for Artillery at Potchefstroom — Contract No. 3 (P.W.D. tender 450): Anderson Andrew (Pty.), Ltd., Johannesburg. £14,995.

Housecraft School, George (P.W.D. tender 442): E. R. Schonken, Kimberley. £30,000.

Residence for Principal, Industrial School, Tempe (P.W.D. tender 461): J. R .Moffet (Pty.), Ltd., Bloemfontein. £1,927.

New Mechanical Workshop at Trades School, Kroonstad (P.W.D. tender 464): J. R. Moffet (Pty.), Ltd., Bloemfontein. £1,067.

Additional accommodation at Police Station, Auckland Park (P.W.D. tender 353): Geo. Beckett (Pty.), Ltd., Johannesburg. £13,999 2s. 11d.

Additions to Melbourne Road Coloured School, Durban: Short & McDonald. £1,750.

BRIDGES AND MATERIALS.

Umhlangankulu River Bridge (P.W.D. tender 454): Leo Catella, Durban. £12,000.

CHEMICALS, LABORATORY EQUIPMENT, ETC.

Laboratory glassware (tender S.O. 601): (1) Macdonald, Adams & Co., Ltd., Johannesburg; (2) Heynes, Mathew, Ltd., Cape Town.

COOKING EQUIPMENT, ETC.

Dough mixer for Cinderella Gaol, Boksburg (P.W.D. tender 457): Macadams, Ltd., Johannesburg. £145, delivered, duty paid.

DRAINAGE AND SANITATION.

Soil and waste water drainage and sewage disposal works at Housecraft School, Potchefstroom (P.W.D. tender 477): B. Karpes & Co. (Pty.), Ltd., Pretoria. £4,389.

Waterborne drainage at Industrial School, Standerton (P.W.D. tender 473): B. Karpes & Co. (Pty.), Ltd., Pretoria. £960.

Latrines and installation of waterborne drainage at Forest Station, George (P.W.D. tender 500): J. G. Smith, Knysna. £465.

ELECTRICAL EQUIPMENT.

Switchboards (P.O. tender 816): Rogers-Jenkins & Co. (Pty.), Ltd., Johannesburg.

FURNITURE, FITTINGS, ETC.

Steel shelving for State Library, Pretoria (tender S.O. 733): S.A. Steel Equipment Co. (Pty.), Ltd., Johannesburg. £279 10s.

Barrack forms for Department of Defence (tender S.O. 643): Lorio Bros., Pretoria. £3,770 16s. 8d., f.o.r. Pretoria.

ROADS AND ROAD-MAKING EQUIPMENT.

Road graders (2) for Hereford Settlement (tender S.O. 613): W. S. Thomas & Co. (Pty.), Ltd., Johannesburg. £92 each, f.a.s., New York.

Crushed stone (Tvl. Prov. tender 6/1940): Brakpan Mines Stone Crushers, Ltd., Brakpan.

WATER SUPPLY AND IRRIGATION EQUIPMENT.

Boring for water (tender I.D. 247): Gearings, Ltd., Johannesburg.

Boring for water (tender I.D. 329): P. N. Genis, Zandsloot.

Boring for water (tender I.D. 359): J. S. Mundel, Rustenburg.

Boring for water (tender I.D. 358): Gearings, Ltd., Johannesburg.

MISCELLANEOUS.

50 steel posting-boxes (P.O. tender 836): Thos. Barlow & Sons (S.A.), Ltd., Johannesburg. £200.

400 coils barbed wire (tender S.O. 718): Clyde Trading Co., Ltd., Johannesburg. £1 2s. 6d. per coil, f.o.r. Durban.

Book lift for S.A. Library, Cape Town (P.W.D. tender 435): Waygood-Otis (S.A.), Ltd., Cape Town. £313.

116 steel windows (Ref. 25/1/886): Universal Manufacturing Engineering (Pty.), Ltd., Johannesburg. £225, f.o.r. Johannesburg.

200 doors (tender S.O. 714): E. R. Pollack (Pty.), Ltd., Johannesburg. 15s. 8½d. each, f.o.r., Johannesburg.

120 coils barbed wire (tender S.O. 715): Otto Landsberg & Co., Cape Town. £141 f.o.r. Cape Town.

Cattle dipping tank at Houtpoort Reformatory (tender S.O. 723): A. van Veelen, Heidelberg. £160.

Galvanised wire for Department of Posts and Telegraphs (tender S.O. 721): (1) Haggie, Son & Love, Ltd., Johannesburg; (2) Patlansky Bros. & Schauder, Port Elizabeth.

Slow combustion stove for Officers' Mess, Central Prison, Pretoria (P.W.D. tender 437): Aga Heat (Africa) (Pty.), Ltd., Johannesburg. £256, f.o.r. in bond, Durban.

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