LABORATORIUM VOOR SCHEEPSCONSTRUCTIES

TECHNISCHE HOGESCHOOL – DELFT

RAPPORT Nr. SSL 108

BETREFFENDE:

TESTING FACILITIES AND WORK OF THE SHIP STRUCTURES LABORATORY.

Fig.1 600 tons tension–compression fatigue machine.

Testing facilities and work of the Ship Structures Laboratory

(Technological University - Delft - The Netherlands)

(Department of Naval Architecture).

Director: Professor Ir. H.E. Jaeger
Chief Scientific Officer: Ir. J.J.W. Nibbering
Scientific Officers: Ir. P.A. van Katwijk
Ir. F.X.P. Soejadi
Management: H. Boersma.

Main testing facilities.

1e 600 tons tension - compression fatigue machine (fig. 1), (Amsler).
Length 22,00 m (72').
Maximum dimensions of specimens: 12,5 m x 5 m x 2 m
(41' x 16'.5" x 6'-6").
Frequency: Between 30/min. and 6/min. depending on load and specimen length.

2e 100 tons fatigue-testing machine (Amsler) (fig. 2).
Maximum length of specimen: 1400 mm (4'-7").
Frequency: 250/min. and 500/min.

3e 6 tons fatigue-testing machine (Losenhausen).

4e 35 tons static testing machine (Amsler).

5e Special large-stroke fatigue testing machine for investigations of reinforced plastics.
(Max. stroke 200 mm (8"), ultimate load 1500 kg; max. dimension of specimen: 2000 x 350 x 35 (6'-5" x 14" x 14").

6e Impact-testing apparatus, metallurgical equipment, analog and digital recording apparatus for low and high speed phenomena (e.g. low-cycle fatigue and brittle fracture).

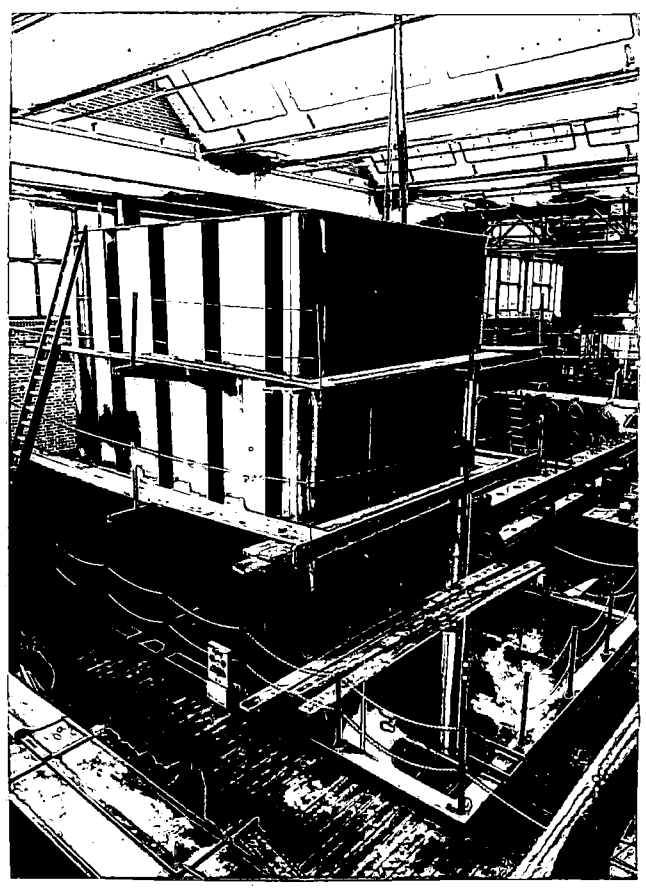


Fig. 3 Bulkhead – tank.

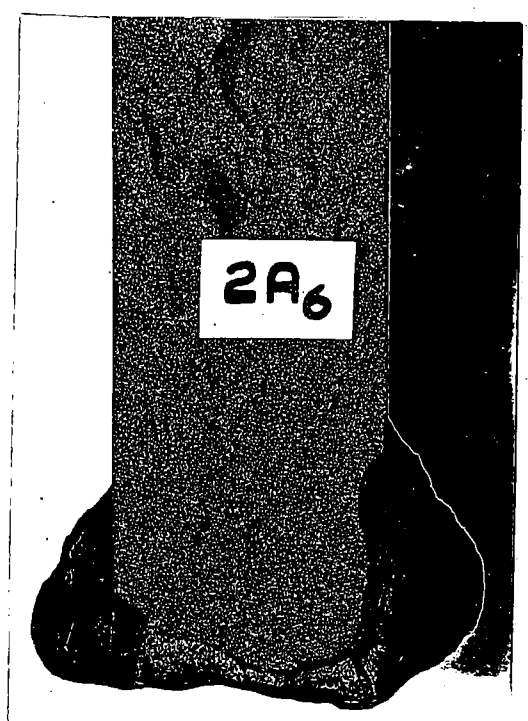
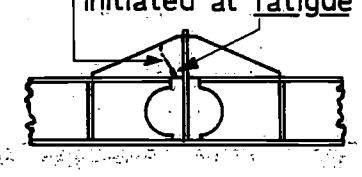


Fig. 5 Brittle fracture initiated at fatigue crack.



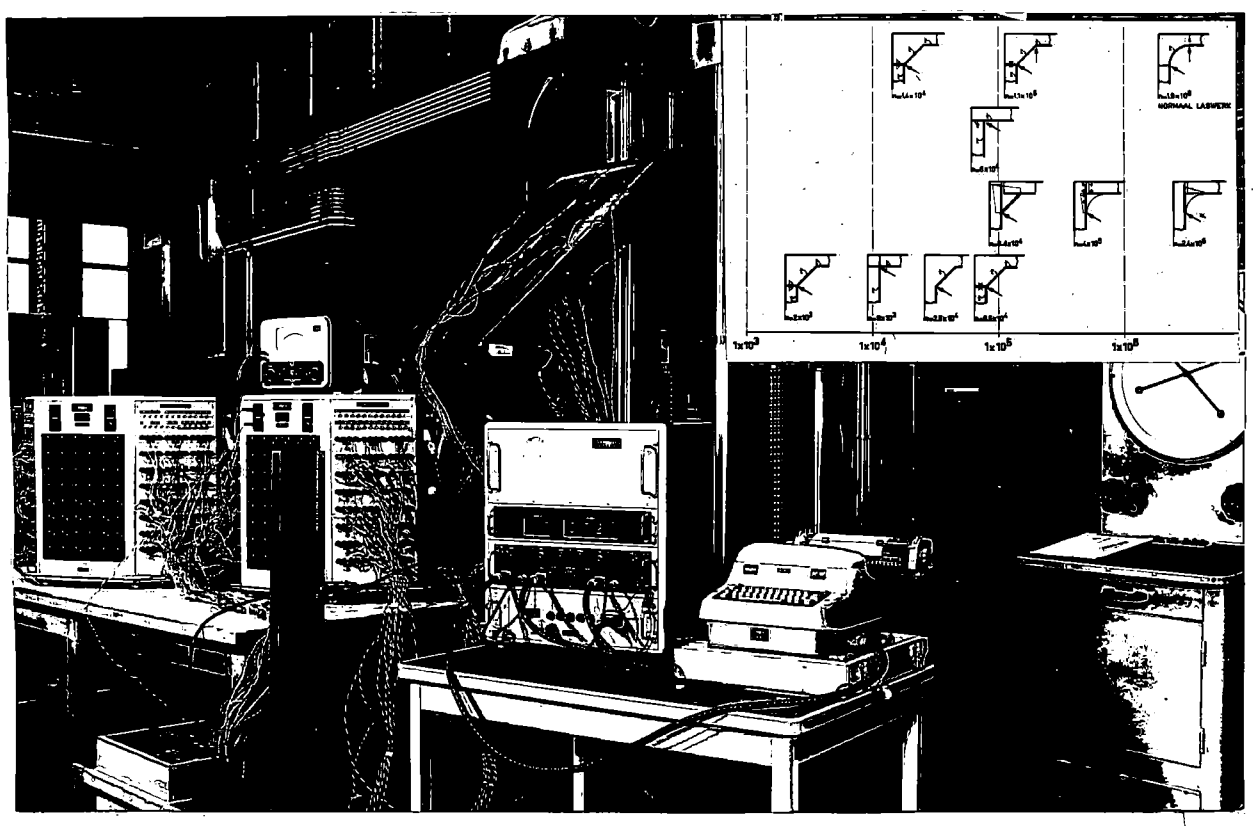


Fig. 2 Fatigue loading of full size orthogonal connections of frames in 100 tons pulsator.

7e Bulkhead-testing tank. The walls consist of two types of full size corrugated bulkheads and two types of flat bulkheads. Dimensions of the tank: 10 x 5,5 x 4,5 m fig.3
(33' x 18' x 15').

Principal research projects.

Current investigations.

A Low-cycle fatigue and brittle fracture

1e Tensile testing at low temperature of full-size ship-structural components previously subjected to low cycle fatigue loading. (see fig. 1 and fig. 5).

2e Idem combined with drop-weight impacts. (dynamic initiation).

3e Drop-weight testing of small plate specimens (of full thickness) containing fatigue-cracks, weld cracks, or artificial notches covered by welding.
Main purpose: study of initiation characteristics.

1e, 2e and 3e for mild steel (=St 42) and higher strength steel (St 52).

4e Axial low cycle fatigue testing of plain specimens of various steels. The resulting damage is investigated with the aid of Charpy-bars made out of the specimens.

B Applied mechanics

1e Study of the elastic stress distribution in corrugated bulkheads and flat bulkheads. (fig. 3).

2e Matrix calculus applied to orthogonally stiffened plates subjected to varying waterpressure.

3e Statistical survey of unfairness of bulkhead-plating.

4e Study of end fixity of bulkhead-panels.

5e Effective breadth of bulkhead plating at horizontal and vertical stiffeners.

C Derricks

Programming of calculation methods. Study of dynamic influences.

D Loads in seaway

Programs for the calculation of longitudinal bending moments based on the existing computer programs for ship-movements are being developed.

E Glass fibre-reinforced plastics

1e Measurement of strain and deflection of the hull of a L.C.A. boat subjected to longitudinal bending and of a bulkhead subjected to waterpressure.
Hull and bulkhead are sandwich-structures.

2e Creep tests at elevated temperatures of sandwich-plates containing different types of foam.

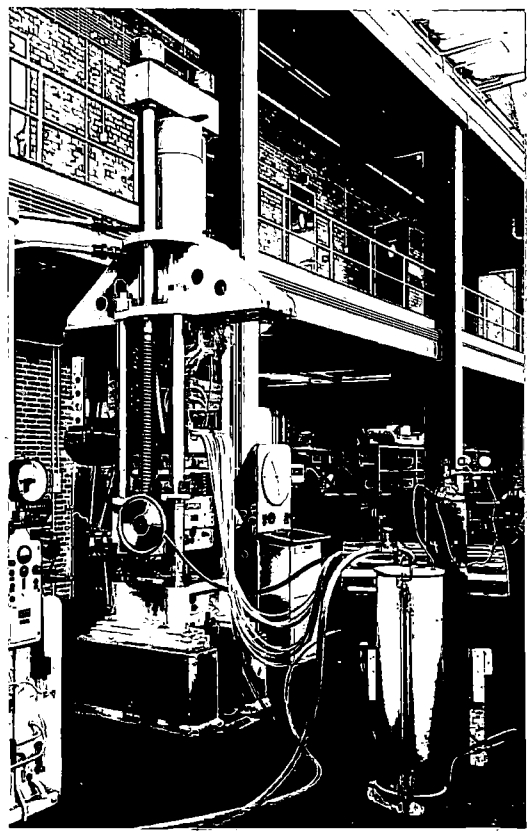


Fig. 4 Watertightness-test of fatigue-loaded riveted tank.

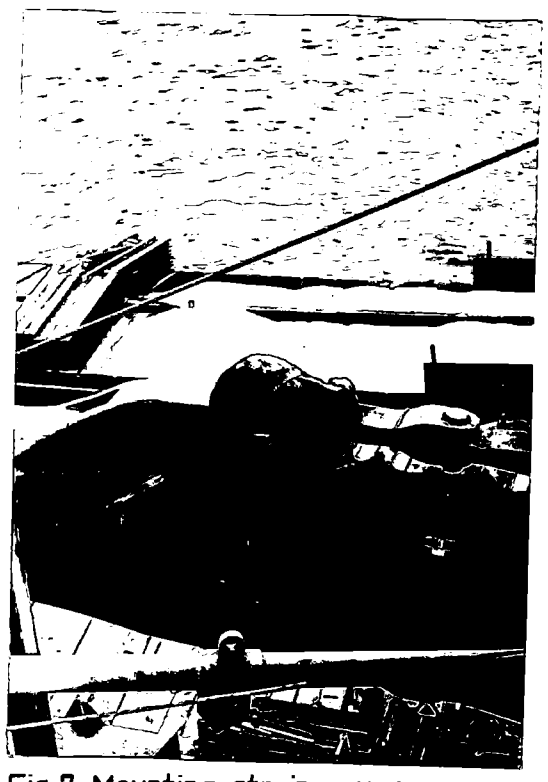


Fig. 7 Mounting strain gauges on suction-pipe.

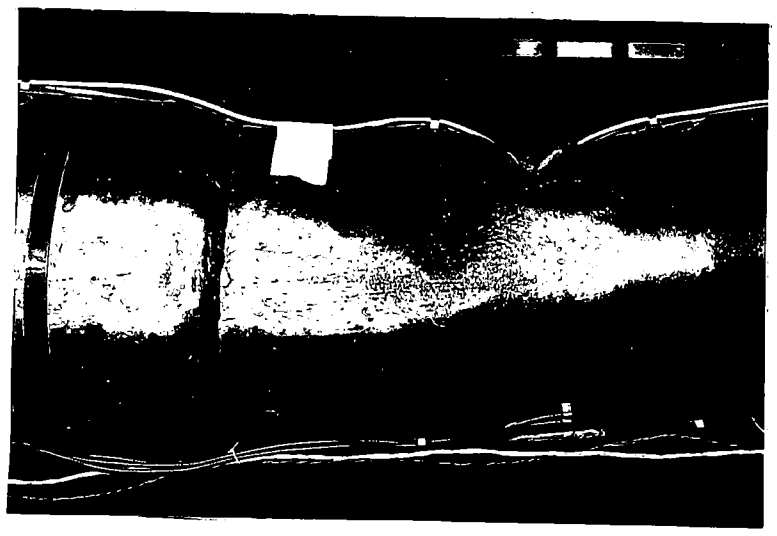
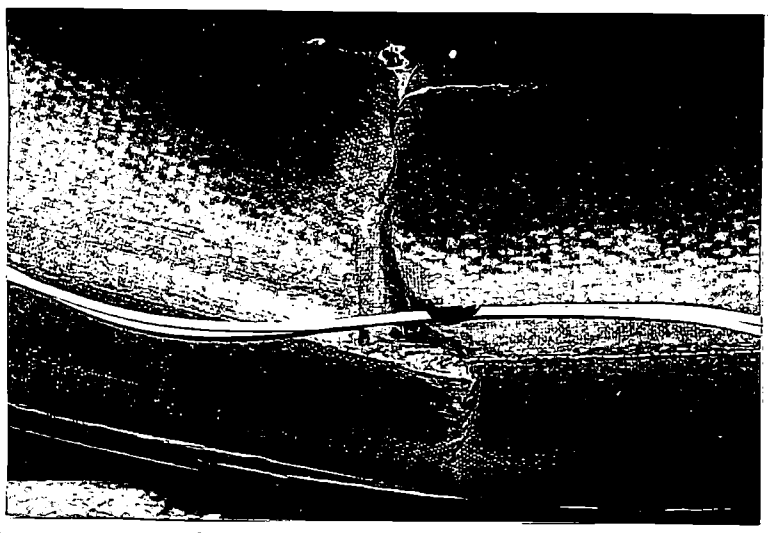


Fig. 6 Steel derrick
G.R.P. derrick



F. Former investigations

1e Static strength, fatigue-strength and waterlightness of riveted and bolted connections. (fig. 4).

2e Fatigue-tests on large, completely welded, diesel-engine-frames.

3e Experimental determination of bending moments for 3 models of different fullness in regular waves.

4e Fatigue-testing of many types of full-size angle connections of the beam-knee type. (fig. 2).

5e Fatigue and impact tests on glass-fibre-reinforced plastics (sandwich). Influence of breadth on static strength.

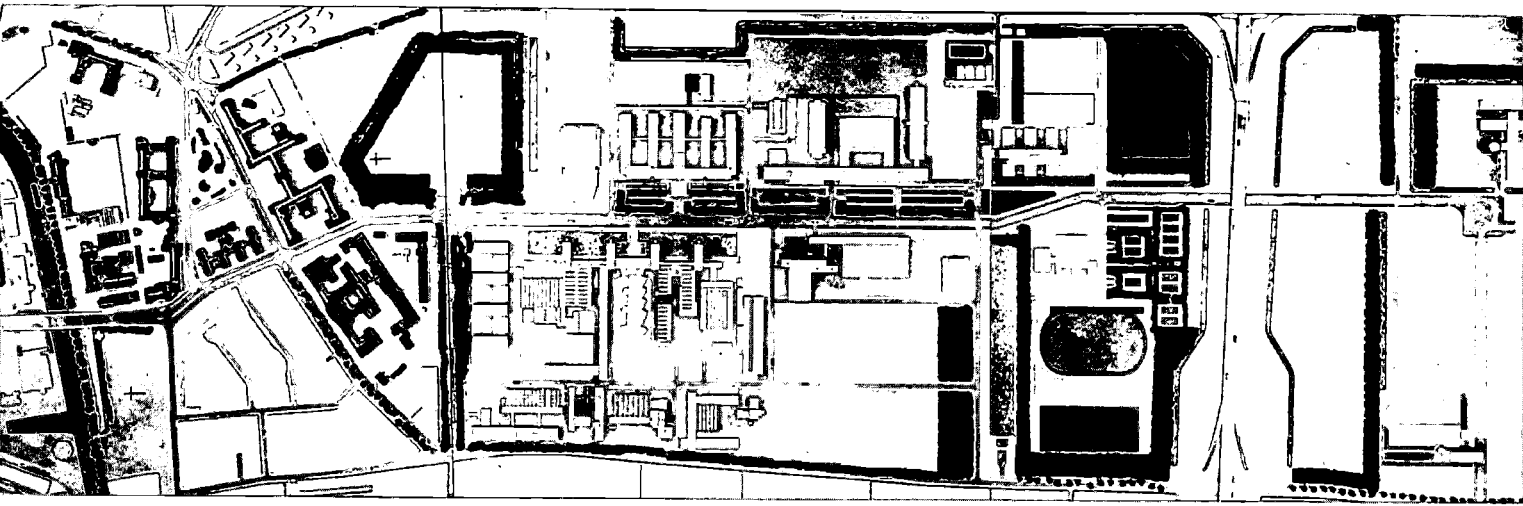
6e Elastic stresses in corrugated bulkheads. (fig. 3).

7e Stress distribution and collapse strength of cylindrical and various types of stepped derricks subjected to end-moments. (fig. 6).
Idem for a G.R.P. derrick.

8e Various shipboard-measurements e.g. at expansion joint in large passenger vessel, on 120 tons derrick, on pushboat-connection, and on suction-pipes. (fig. 7).

9e Studies of causes of fractures in ships.

Model of the "Technische Hogeschool" Delft



The "Technische Hogeschool" of Delft

In 1842 a "Koninklijke Academie" for the education of civil engineers, civil servants and commercial apprentices was established by King William II. In 1864 the Academy changed its name to "Polytechnische School".

After a long dispute between the Governors of the School, the Government and Parliament the School became a technological university in 1905, was granted the right to confer a first degree in various branches of Engineering and a Doctorate in Technical Science and its name became "Technische Hogeschool". (T.H.).
Until 1956, the "Technische Hogeschool" of Delft was the only institute in Holland awarding the "Ingenieur" degree (Ir.). In that year a second technological university – the "Technische Hogeschool" of Eindhoven – was founded and courses commenced in September 1957.

The "Technische Hogeschool" is an autonomous, state-financed, establishment for engineering education at University level coming under the Government Minister of Education, Arts and Science.

Teaching and research go hand in hand at Delft and degrees are awarded in 12 branches of engineering.

Nearly 7,500 students from Holland and abroad study

The Senate of 1905

at the T.H. Delft during the autumn and spring terms under the guidance of 120 full-time professors, 52 part-time professors, 28 lecturers, 440 scientific staff and 471 scientific assistants. 2135 persons are employed on administrative and other duties, and the annual salary budget is about *f* 34 m.

f 4,5 m. are spent each year on material supplies, purchase of new equipment and maintenance of existing equipment and buildings.

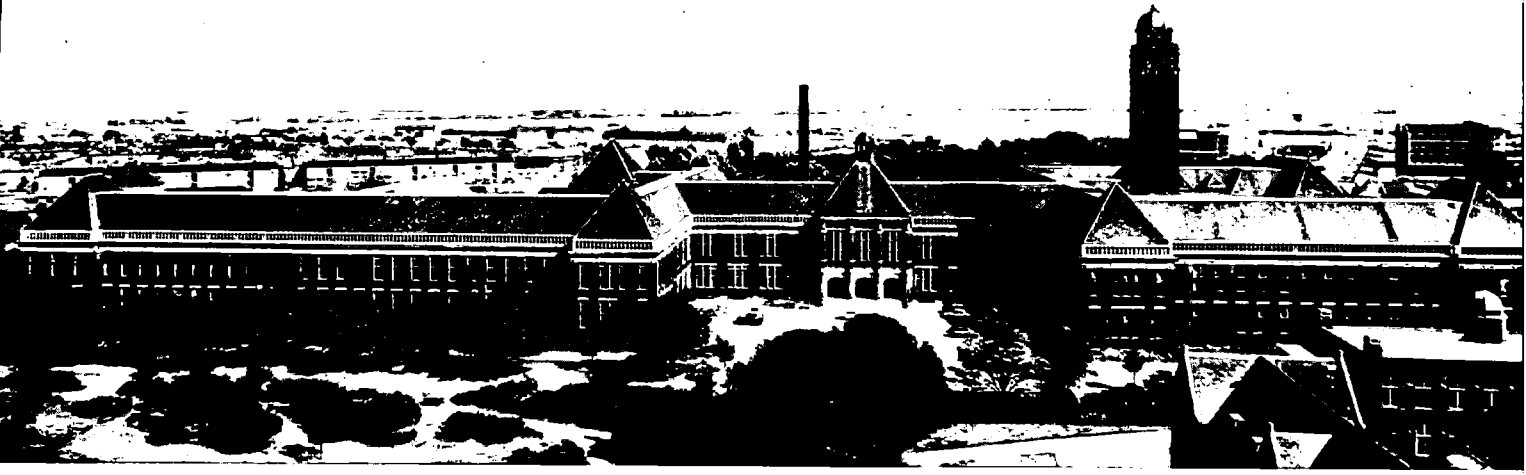
f 25 m. per annum, over the next five years (1963–1968) have been allocated to implement a building programme estimated to cost *f* 300 m. in total.

The Board of Governors

The "Technische Hogeschool" is administered by a Board of Governors, meeting monthly, appointed by the Queen and mainly chosen from well known industrialists. The Board is responsible for the non-academic administration and the new buildings programme. The T.H. thus maintains close links with industry and this is reflected in the cognizance given to modern developments in science and technology throughout the curriculum.

The Secretary of the Technische Hogeschool

The chief executive officer of the T.H. is the Secretary who is responsible for the central administration and has an office staff of more than 220.



Main Building

The Senate

The Senate, comprising all the professors, is reponsible for all academic aspects of the work of the T.H. The Rector Magnificus, appointed by the Queen, presides over the Senate. He holds office for three years and can be re-appointed. The Con-Rector is elected annually by the Senate and acts as its Secretary. The Senate meets twice yearly.
For its day to day activities and for the award of the "Ir." degree the T.H. is organised in Departments. Between Senate meetings, the Rector, the Con-Rector and the Chairmen of Departments meet weekly as "The Rector and his Assessors".

The Committee of Management

The President of the Board of Governors, the Rector and the Con-Rector together with the Secretary meet regularly to discuss the policy and administration of the T.H.

Students

The number of students currently enrolled at the T.H. is about 7,500 compared with 2,500 in 1939. It is planned to increase the number to a maximum of 10,000 by 1970.
Since 1905 18,700 students have passed through Delft but of these only 14,600 graduated. The annual number of graduates from Delft now is about 600.

The normal age of entry is 18 years. Students who hold a leaving certificate of a Dutch secondary school are allowed to sit for an examination. Foreign students may be admitted by presenting a corresponding diploma. The nominal duration of the course is 5 years and generally speaking each study year is completed by examination. In practice the average length of study is between $6^1/_2$ and 7 years. 10 per cent of the students are married and more than 20 percent are working to earn their living concurrently with their study. More than half the total number of students are unable to obtain postponement of their conscript military service whilst they are attending the University and thus their studies are interrupted. Only 60 percent of each new enrolment of freshmen succeed in finishing their studies by graduation. Since careers in architecture, chemistry and engineering became available to women, the T.H. has enrolled about 100 women students.

Personnel

To provide its 7,500 students with the necessary facilities the Technological University employs 3250 persons.

The staff of the T.H. comprises: academic staff; scientific staff; scientific assistants, who are mainly senior students; technicians; clerical staff; etc.

The academic staff comprises:

full-time professors,
part-time professors,
full-time lecturers,
part-time lecturers,
the librarian.

The Board of Governors are responsible for the appointment of personnel other than those appointed by the Queen, which latter include the professors, the lecturers, the secretary and the librarian.

Ranks and corresponding salaries and wages correspond to those of the civil service.

Office Interior Main Building

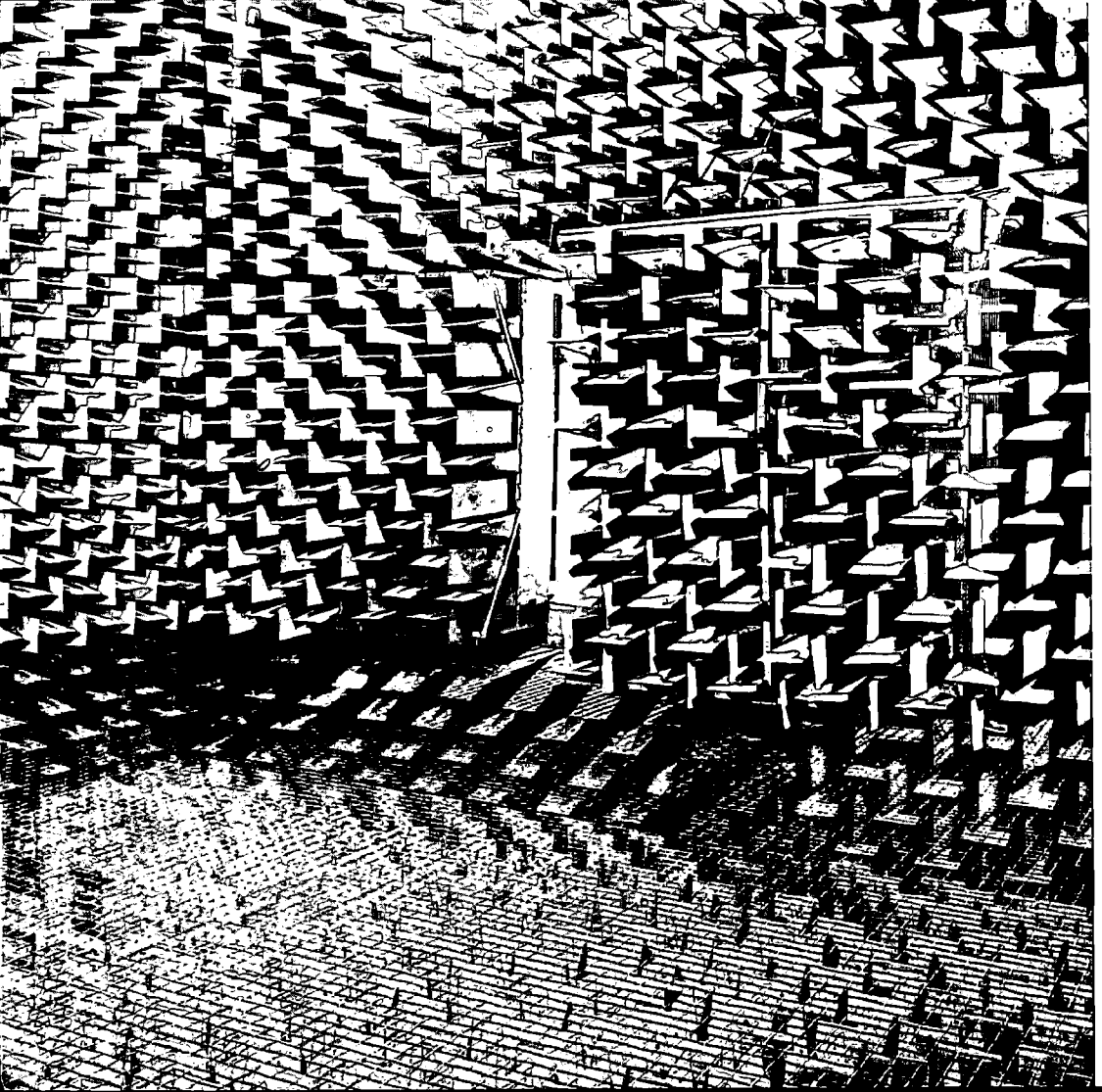
Finance

In the Government budget for 1963 provision was made for the Ministry of Education, Arts and Science to a total sum of *f* 2 milliard. Of this amount *f* 48.4 m. was allocated to the "Technische Hogeschool" to cover operational expenditure for the calendar year 1963.

In contradistinction to many educational establishments in other countries the T.H. has no funds of its own and receives no large private grants or endowments. It is financed almost entirely by the Government.

Student fees make a very small contribution to revenue. An annual fee of *f* 200 is payable for 4 years, there is an annual registration fee of *f* 10 and small fees for examination and on graduation. These revenues do not exceed $^3/_4$ million guilders.

A special foundation "Delfts Hogeschool Fonds" supported by contributions from Delft alumni and from industry subsidizes special research work and other activities in the general interest of the T.H.



Anechoic Chamber

Buildings

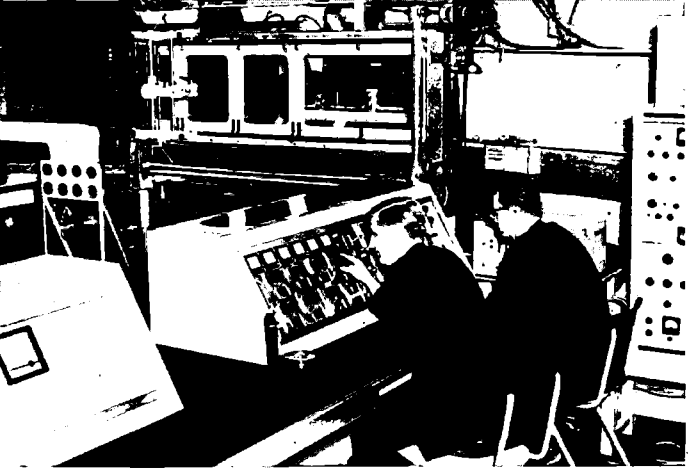
Laboratory for Applied Physics

His first panorama of the present 150 acres in the Wippolder south-west of Delft will fascinate the visitor and give him the impression that Delft has more to offer than just "pottery". Large buildings and laboratories in the new University City dominate the skyline of present day Delft.

All this building activity has become necessary because of the very great increase in the student population, since the second world war and of the rapid industrialisation of the Netherlands during the same period. The demand coming from industry for highly qualified engineers is at the moment insatiable.

The extensive current building programme is scheduled for completion in 1970 at an estimated total cost of *f* 300 m. To date (1963) about *f* 150 m. has been spent.

There are some 35 laboratories and buildings of the "Technische Hogeschool" on the new site or scattered through the old city and a number of these are described in the following paragraphs.



Model-testing in the Windtunnel

Wind tunnel

The wind tunnel, belonging to the Department of Aeronautical Engineering, was the first project built in the Wippolder in 1951. There is a low turbulence tunnel and a supersonic tunnel. The airspeed developed in the former is approximately 250 m.p.h. and it is mainly intended for tests on stability and performance. The supersonic wind tunnel is a so-called "blow down" type. During short runs up to 40 seconds an airspeed of three times the speed of sound can be maintained.

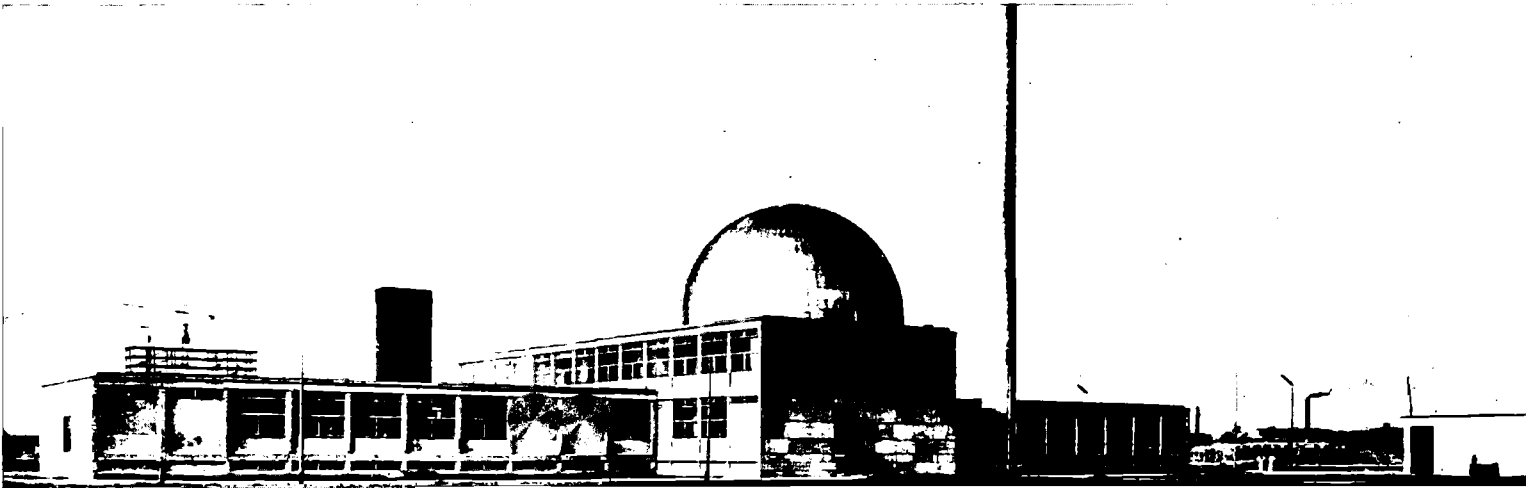
Reactor Institute

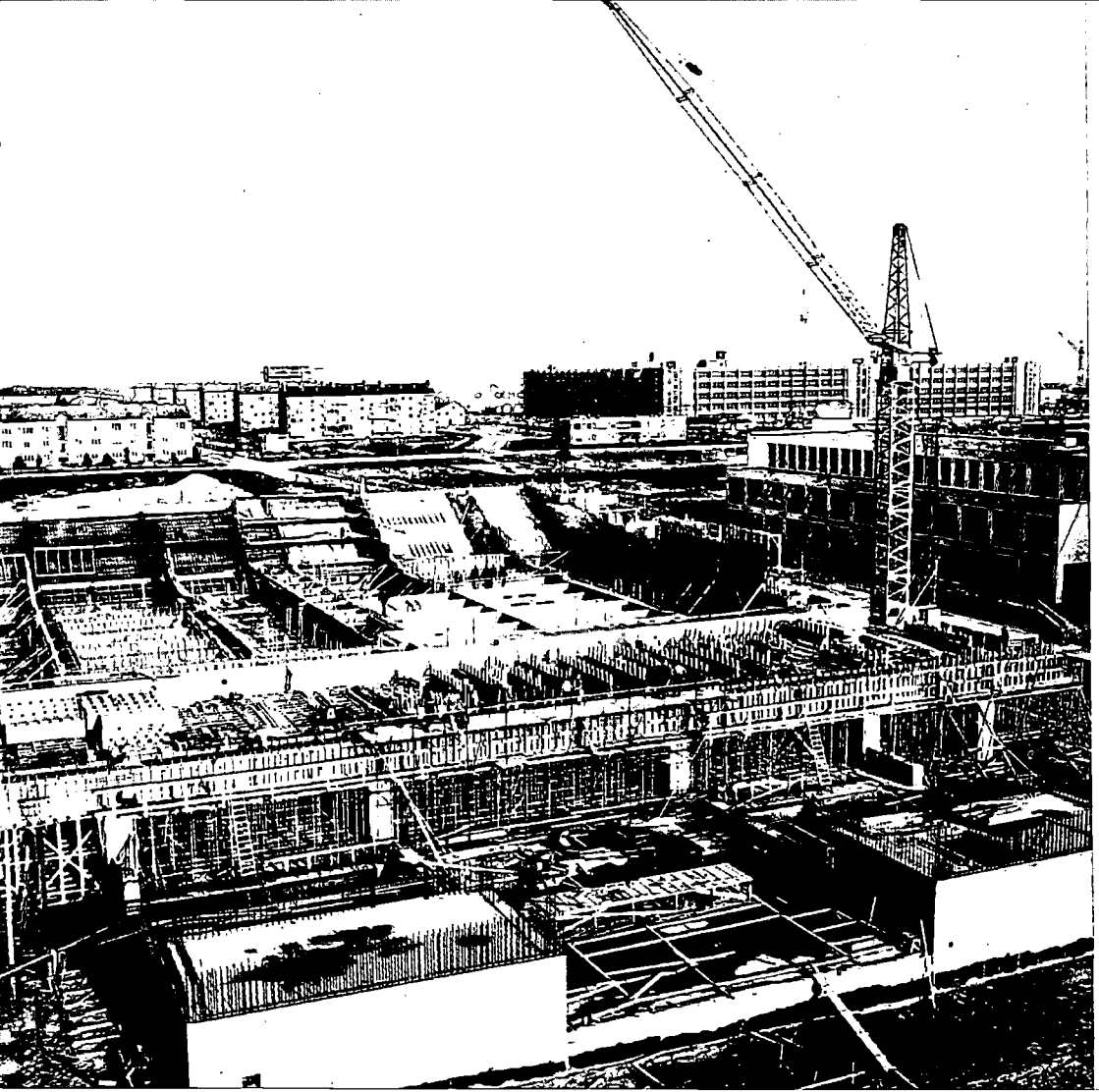
The Delft nuclear reactor is of the open swimming pool type rated at 100 kw, bought in 1957 by the Ministry of Education and shown in Amsterdam on the Exposition "The Atom" in the same year.
The reactor is a training unit for students of all the universities in Holland under the management of the Board of Governors of the T.H.

The design of the reactor is very versatile and it offers many special facilities for research. A 28 m. high airtight dome is constructed over the reactor.

Five laboratories for reactorphysics, radiochemistry nuclear physics, tracerchemistry and radiobiological experiments respectively are grouped around this impressive building.

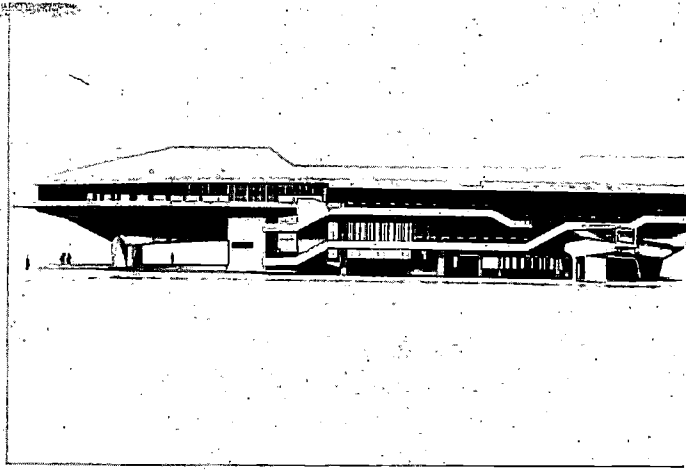
Nuclear Reactor





Auditorium under construction

Auditorium



Model

The auditorium, with a cubic capacity of 75,000 m³, currently being built, will be one of the most interesting projects in the Wippolder, particularly from the point of view of its exterior architecture. This building, designed by Prof. van den Broek of the Department of Architecture, shows that Delft still leads in modern architecture.

There will be an "aula" on the first floor with 1250 seats. Around it will be grouped meeting and conference rooms for the Board of Governors and the Senate.
These arrangements will provide Delft with unique facilities to act as host to international conferences, conventions, symposia and the like.

In addition, the auditorium will contain four large lecture theatres, for the Department of Applied Physics, seating 1200 students. This project is scheduled for completion during the latter half of 1964 and costs *f* 10,5 m.

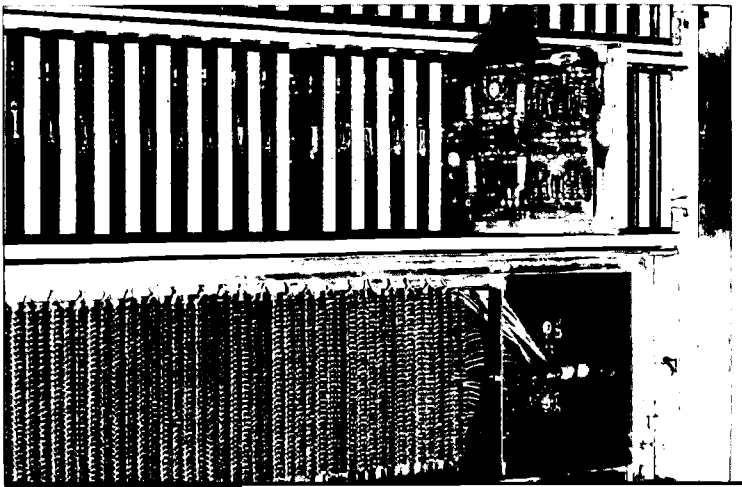
Central Library

Library

The Central Library (300,000 books) provides all students, professors and research workers in the T.H. with the literature they need. With the help of modern technical aids such as photo-reproduction, and a teleprinter installation, the library can provide the scientific worker with the necessary material quickly, whether the data can be found in its own collection or have to be obtained from any other library in Holland or abroad.

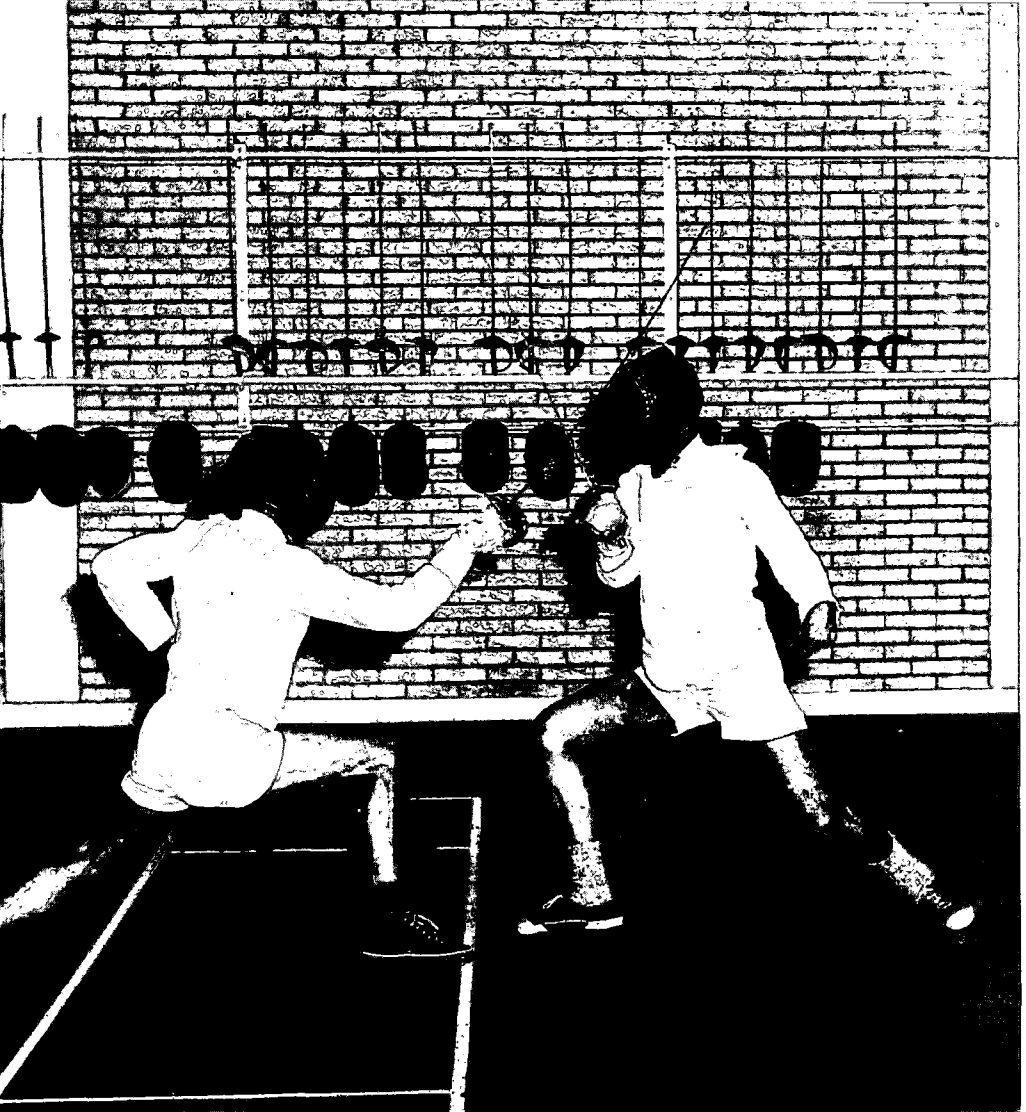
Computer

Computer elements



The Computer Service in the Department of General Science is developing rapidly. The present facilities of ZEBRA, a small electronic digital computor are insufficient.
The Minister of Education has approved the purchase of a modern general purpose computer, the Telefunken digital type TR4, an expensive unit costing *f* 2,5 m. Among its features are high computing speed, 1000 times faster than that of ZEBRA, a high degree of reliability and considerable flexibility, with the ability to make 50,000 elementary calculations per sec.

With this modern apparatus, the Computer Service hopes to tackle a new range of problems of increasing complexity, such as are frequently submitted by various departments, but at the moment are wellnigh insoluble within reasonable time. The students will also be able to use these facilities for education and research.



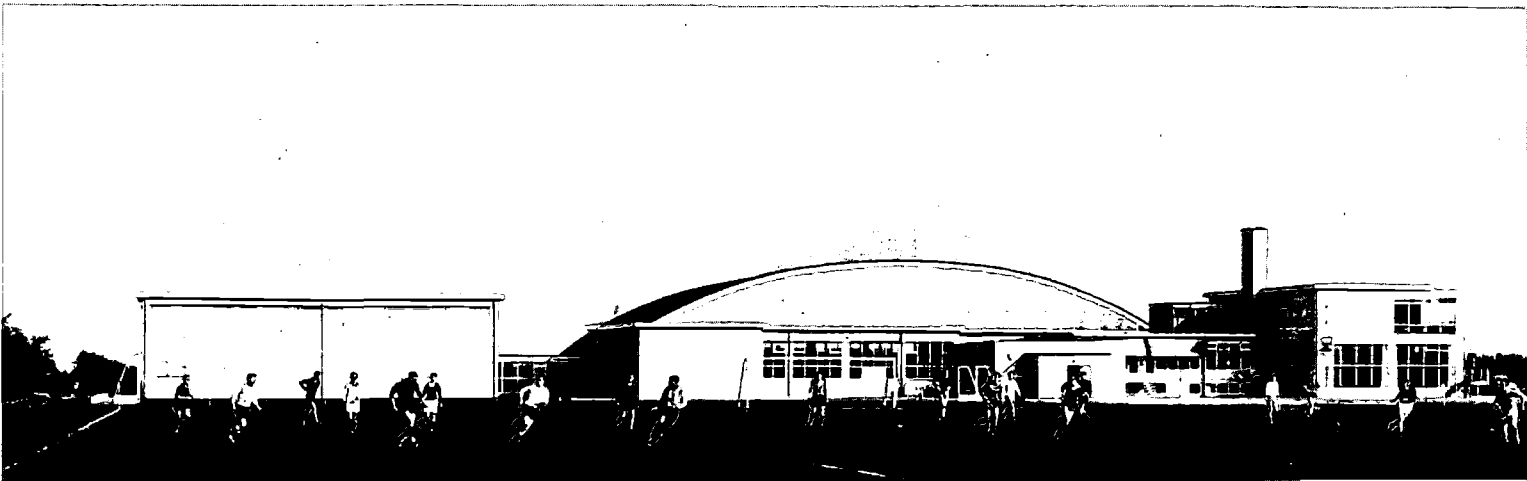
Fencing

Sports Centre

This centre, fully equipped for all branches of athletic activity is surrounded by tennis courts and fields. The building, made possible by a munificent gift from a Dutch industrialist and a government grant was completed and officially declared open in 1959. After the ceremony, the students moved in and there were inaugural matches in fencing, judo, badminton, indoor hockey, tennis etc.

Each year about 3.000 students take part in 17 different sports. This sportshall is a unique example of what Holland is doing to create a student community with "mens sana in corpore sano".

Sports Centre



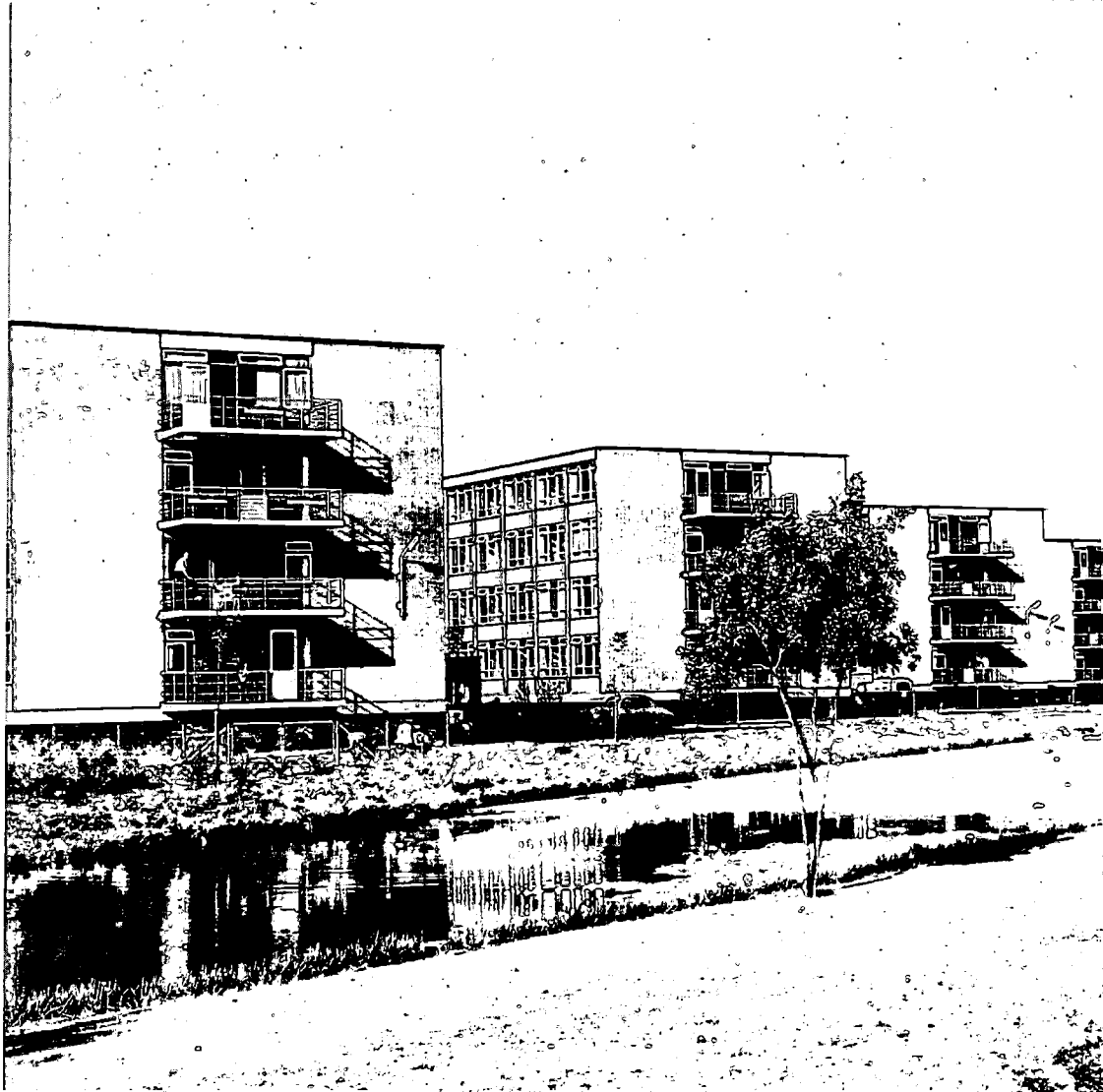
Students' living and welfare arrangements

The first foundation for students' housing was established at Delft in 1946. All kinds of students' lodgings are found in and around Delft. Along the canals and elsewhere in the town are old rebuilt houses available to the students.
In addition there is a campus-like arrangement of pavilions, similar to army huts, each accomodating 17 students (total to 275 students).

A later provision is four blocks of students' flats, each of four floors, having accommodation for 18 students per floor (total to 280 students).
A new project of the foundation is a 10-storey block of student rooms with 15 to 18 students housed on each floor (total to 150 students), and a complex of residential student hostels for 575 students is planned.

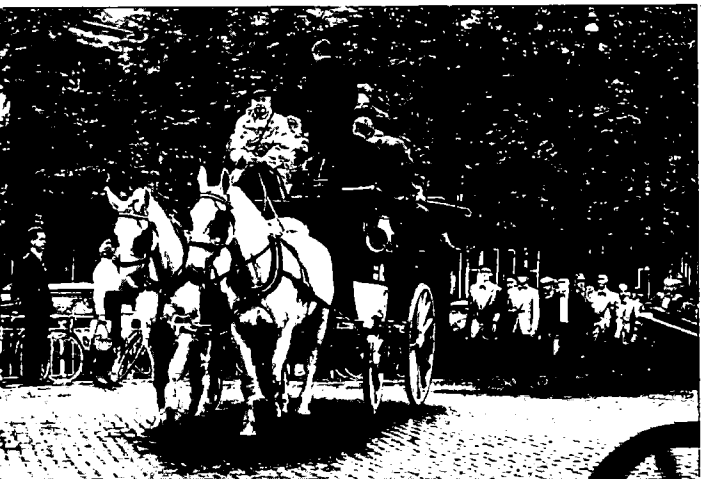
In view of the still rising building costs the Minister of Education has introduced on 1 Jan. 1963 a new scheme for subsidizing the new building projects.
A room will cost at least *f* 46.50 with an additional *f* 23,— for heating, water, gas and electricity, together with service but without meals.

The T.H. has its own physician, who gives medical attention to all students on a voluntary basis.
Provision is made for the students to have an annual



Students' Flats

Procession of Freshmen



check for tuberculosis. There are special low cost arrangements for students' health-insurance.
Students can get a cooked meal at very reasonable prices. In the various students' clubs, meals can be had for *f* 1,20, for which there is a Government subsidy of *f* 0,30. Students, who are not members of a club, can have their meals at the „Mensa". This is a separate organisation, independent of the student clubs. In 1961 a total of 388.470 meals were served at the students' clubs and at the Mensa.

International Courses

Delft is a technical centre with an international character. Each year the international course in hydraulic engineering is held, organized by the T.H. in collaboration with the Netherlands Universities Foundation for International Co-operation (NUFFIC). With the assistance of the World Health Organisation, the T.H. and NUFFIC have organised a second international course, in sanitary engineering.
Such activities, in addition to their educational value, which is very considerable, help to promote international understanding and co-operation.

Looking across the new T.H. towards the Nuclear Reactor