Davis Engineering

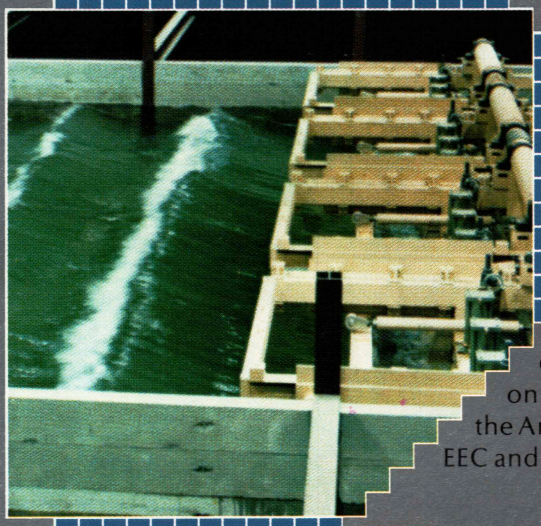
Consulting Engineers offering services in a variety of disciplines...

Davis Engineering

successfully applies fundamental engineering disciplines to a wide variety of applications in a manner that best meets the client's requirements.

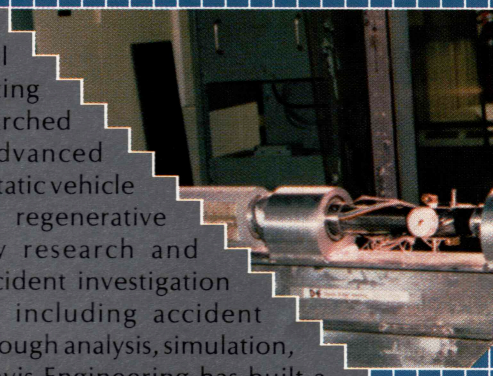
Wave Making Machinery

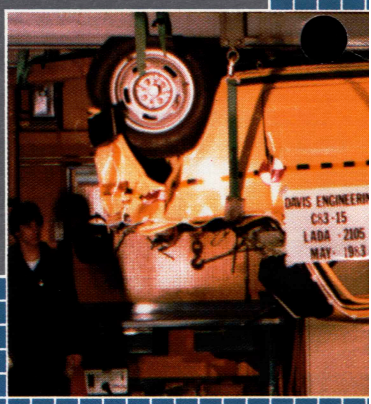
Davis Engineering is a unique source in Canada for the provision of waveboards and their drive mechanisms for use in hydraulic test tanks. When driven by computer, predetermined regular and random sea states can be accurately produced. Single, dual, and segmented waveboard mechanisms are available for specific wave height, period, steepness, and directional requirements. Units for larger basins are modular, providing flexibility of application and ease of movement.



Vehicle Testing and Accident Reconstruction

The vehicle engineering staff has expertise ranging from prototype design of novel vehicular concepts to compliance testing of production units. We have researched and developed a variety of advanced power systems, such as a hydrostatic vehicle drive system incorporating regenerative braking. Vehicle safety research and insurance-oriented accident investigation is also conducted, including accident reconstruction through analysis, simulation, and testing. Davis Engineering has built a number of vehicle compliance facilities adhering to the Canadian Motor Vehicle Safety Standards (CMVSS), available for commercial tests performed by qualified test personnel. A full service is provided for CMVSS assessment of foreign as well as domestic automobiles for the purpose of marketing them in Canada. In addition, in-house documentation is maintained on foreign safety standards — the American FMVSS, the European EEC and ECE, and the French Code de la Route.

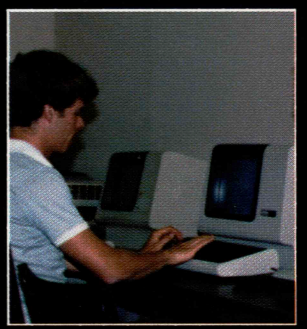




Military Vehicle Engineering

The Military Vehicle Engineering Group is experienced in engineering, logistic support, and systems management. They have designed, developed, and produced mobile military workshops, designed and prototyped product improvements, and conducted military vehicle life extension studies, and are also experienced with the engineering and support of airfield ground support equipment. Complementing them is the **Technical Writing Group,** experienced in writing, illustrating and editing technical manuals for all disciplines.

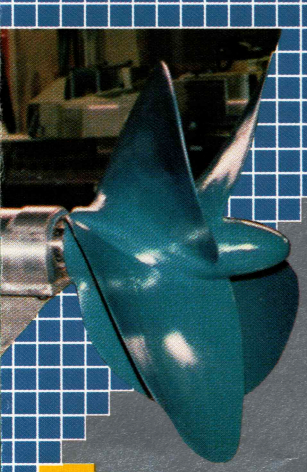
Electronics-Computer Group



This group offers design, prototype, and production capability for electronic equipment and instrumentation Expertise in microprocessor based systems has enabled the group to produce a FORTRAN programmable Data Acquisition System designed to withstand harsh environments. The group specializes in Analog and Digital Instrumentation and Circuit Design, Data Acquisition and Data Reduction Systems, Software Development, Control Systems, and Signal Processing.

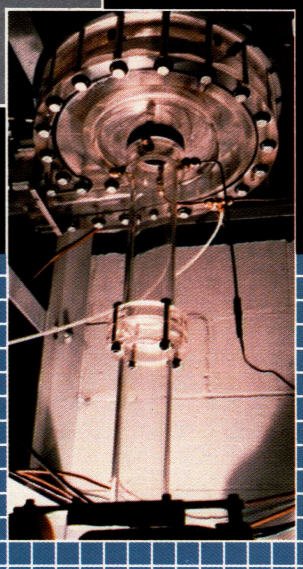
Marine Engineering/Naval Architecture

Experienced staff, particulary in propulsion machinery and associated systems, is available for R & D tasks and Technical Investigations. Studies in shafting alignment, bearing load analysis, stress analysis pneumatic and electronic control systems and gas turbine performance have been conducted.



Mechanical Design and Fabrication

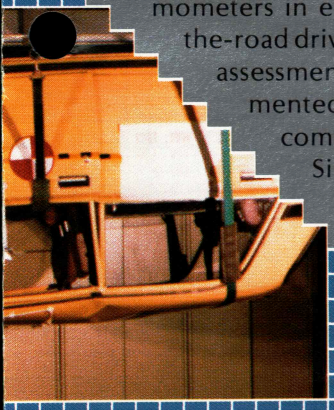
As systems become increasingly complex, analytical studies must be conducted to determine their response under all operating conditions. Unique mechanical systems are analysed statically and dynamically to ensure that the design requirements of stress levels, deflection, and vibratory constraints are met. Some in-house numerical analyses computer programs (FEM) are maintained, but for large structures local external facilities are utilized to ensure a comprehensive analysis is performed. In addition to providing information on dynamic response, models can be generated to answer "What if...?" questions, such as the impact on changing equipment type in a given plant. Application areas are Machinery Dynamics, Control System Analysis, Power Plant Selection, and Stability Analysis and Control.

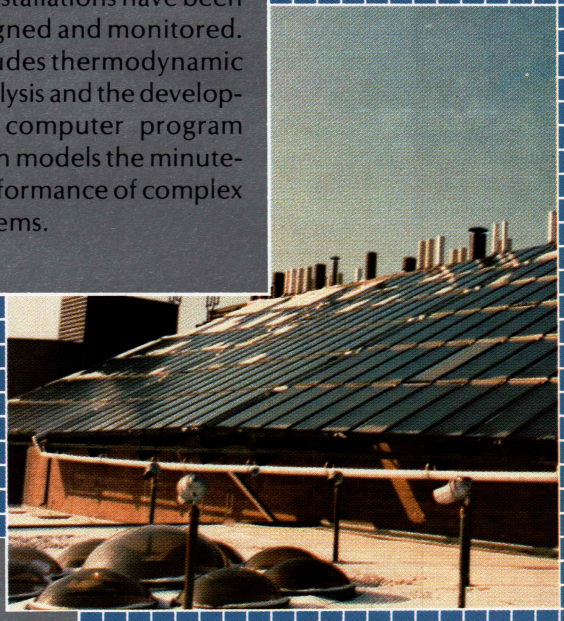


Energy

Our experienced staff assesses automobile fuel consumption and emission in a wide range of temperatures, using chassis dynamometers in external laboratories. Over-the-road driveability and fuel consumption assessments are conducted with instrumented vehicles using in-house designed computer based data acquisition systems. Similar studies have been carried out by instrumenting large diesel locomotive engines. Building energy studies include: investigating heat loss through building envelopes; energy conservation techniques; the application and use of heat pumps; and energy audits of commercial and industrial facilities and their processes.

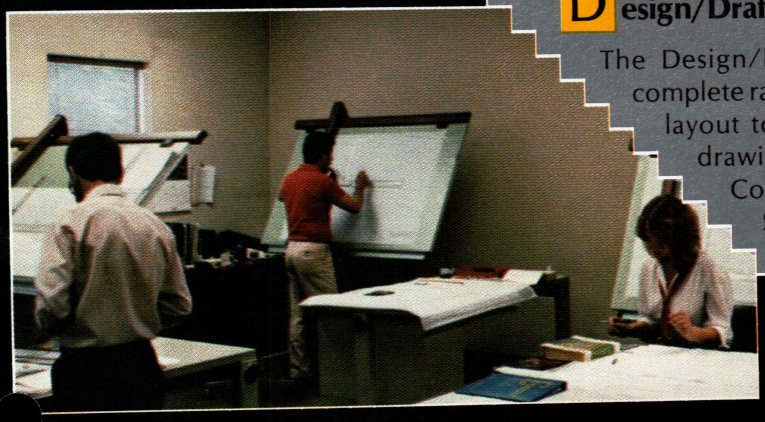
Solar energy installations have been researched, designed and monitored. Research work includes thermodynamic and control systems analysis and the development of a hybrid computer program (SOLAR-C), which models the minute-by-minute performance of complex energy systems.

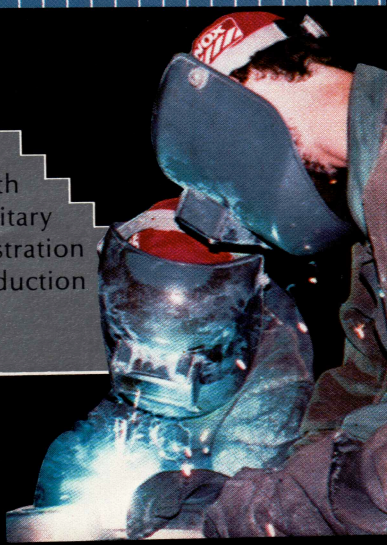




Design/Drafting

The Design/Drafting Group provides a complete range of services from conceptual layout to final design and manufacturing drawings, being experienced with both Commercial and all three levels of Military Standards. A full graphic and illustration capability is available for the production of Technical Manuals.





Should you be interested in any of these areas please request our "Project Profile" information sheets.

Company Profile

Davis Engineering is a Consulting Engineering Company formed in 1975 to provide high technology Research and Development in fields related to Mechanical Engineering. A large proportion of the company's work also encompasses basic engineering design, fabrication, and testing, and the electronics-computer fields.

The company has shown a steady growth pattern, having a staff of fifty persons in 1983. Facilities consist of 12,000 sq. ft. of office space and 10,000 sq. ft. of workshop and laboratory space. Included in the office space is the electronics laboratory, the computer room, and the mechanical design office. The mechanical and electronic workshops provide a capability for developing concepts into prototype hardware.

W.R. Davis Engineering Limited, 1481 Cyrville Road, Ottawa. K1B 3L7 (613) 746-3760
Western Office: 42280 South Sumas Rd., Sardis, B.C. V0X 1Y0 (604) 823-4911
Telex: 053-3862

PROJECT PROFILE
SERPENTINE WAVE GENERATOR

The Davis Serpentine Wave Generator

The need to "go down to the sea in ships", in large container vessels, or supertankers. The drive for exploration and development of offshore resources. These have freshened man's romance with the sea and urged him forward, to the need of a greater understanding of the awesome power of ocean tidal and wave forces.

During recent years, the science of model wave generation has developed rapidly. We at Davis Engineering are proud to be in the forefront of this technology.

Wave makers are systems for flapping large plates (wave boards) in model test basins and flumes. By controlling the type of motion, speed of board movement, water depth, and timing of commands; wave shapes and trains of waves can be made to order for sea testing a vessel model.

The Davis "Serpentine Wave Generator" (WM.5S) was developed in co-operation with the National Research Council of Canada. It is scheduled for installation in laboratories at Ottawa, Ontario; and St. John's, Newfoundland. Due to its modular design and ease of installation into any test basin configuration, the serpentine wave generator has worldwide application.

Serpentine wave generators are new. They consist of many, perhaps hundreds, of narrow individual wave boards. By controlling all wave boards simultaneously, wave conditions not possible with solid board generators can be created. Such waves are typically faster and steeper, and may be directed at a vessel model from many oblique angles. This creates a "sea state" which simulates actual ocean conditions with much greater accuracy than hitherto.

The Davis WM.5S is driven by electro-hydraulic actuators capable of powerful, rapid and precise motion. A computer commands and measures wave board motions, and monitors the model for stress and stability. Computer-generated wave forms ensure that seas are generated accurately and, that seasons and specific areas of the world are also represented. This is an invaluable vessel design tool.

Test Requirements

Tests for sea keeping, stability, durability, and performance may be performed upon:

- free running, scaled ship models;
- moored vessels and platforms;
- bottom-founded structures for harbours and breakwaters;
- wave energy devices;
- and, for coastal erosion.

Test requirements are accomplished with greater accuracy than hitherto via the WM.5S. Wave height sensing capability, computer feedback control, and wave board movement are as follows:

- integral sensors, which average wave height across each wave board, permit reflection absorption;
- the virtue of electro-hydraulic method of wave board activation, is its fast but sensitive response to demands for irregular (random) wave generation;
- and, a choice of wave board flapper (hinged) and piston (linear) movement, or the combined flapper-piston ( ) motion.

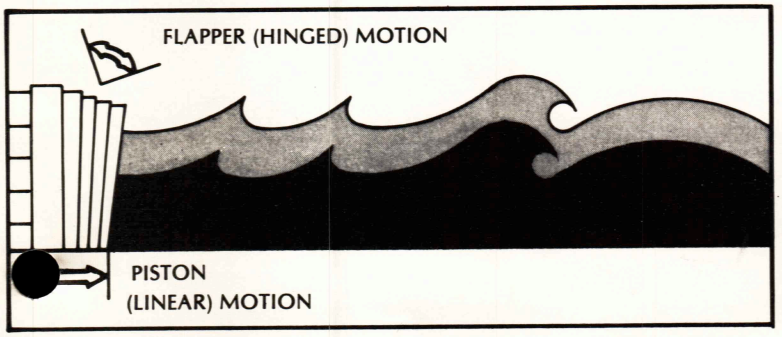
Wave Propagation

The illustrated WAVE BOARD motion indicates uniform flapper movement. These movements can, however, be changed to create various 'sea states' and the following typical wave types and motions:

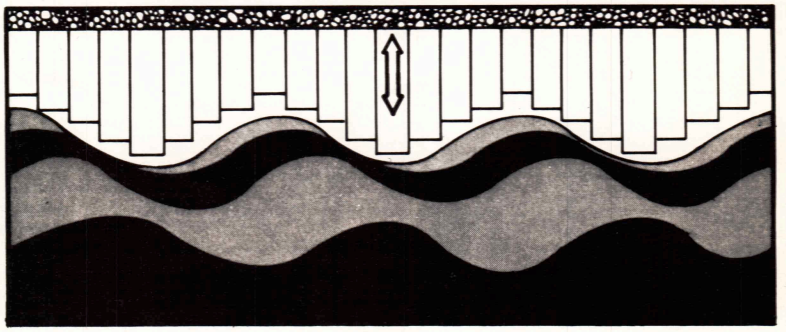
REGULAR WAVES

H = peak-to-trough wave height,
L = wavelength
H = 0.1*L for L = 0.3 to 5.0 m
H = 0.5 m for L = 5.0 to 9.0 m
H to be displacement limited for L greater than 9 m

Side view



Top view



The Davis Serpentine Wave Generator

This is obtained at a depth of 3 m with the hinged flapper mode, and at a depth of 1.5 m with the piston mode.

Minimum Performance: H/L = 1/100

These requirements apply to waves generated normal to the wall with all segments in phase. Regular waves with angles ranging from -60 to +60 degrees relative to the normal are also generated for L 1.25 m by changing phase along the wall.

Note: H = 0.5 m corresponds to a survival condition wave of H = 25 m at scale 1/50.

IRREGULAR WAVES

The WM.5S will generate an ITTC-78 open spectrum with significant wave height = 0.3 m, and average period T1 = 2.0 sec. with Gaussian distribution of wave elevation. This spectrum will be generated with all wave boards operating in phase, with the hinged flapper mode at a depth of 3 m; and, the piston mode at a depth of 1.5 m.

It can also produce the same spectrum with cosine squared spreading over an acrc from -60 to +60 degrees relative to the normal to the plane of the wavemaker.

General

The wave boards provide wave absorption, simultaneously with generation, by using feedback sensors to measure horizontal velocity and wave elevation on the boards.

The WM.5S has sufficient displacement to allow control of the second order boundary conditions. This is required for proper generation of group-bound long waves, and suppression of spurious free-running long waves, when generating wave spectra at depths ranging from 0.4 to 3 m.

WM.5S Data Summary

Each wave board:

Height ..... 2.0 m
Width ..... 0.5 m
Linear Travel (piston) ..... 0.4 m
Board (Flapper) Hinged Angle .. 15°

The height of each wave board is chosen for optimum performance over the range of wavelengths from 1 to 10 m. This when operating in the hinged flapper mode, with water depth 3 m and hinge depth 1.5 m.

Wave Board Drive (Electro-Hydraulic)

Actuator, electro-hydraulic
..... 5,000 lb/board
Hydraulic Operating Pressure
..... 3,000 psi

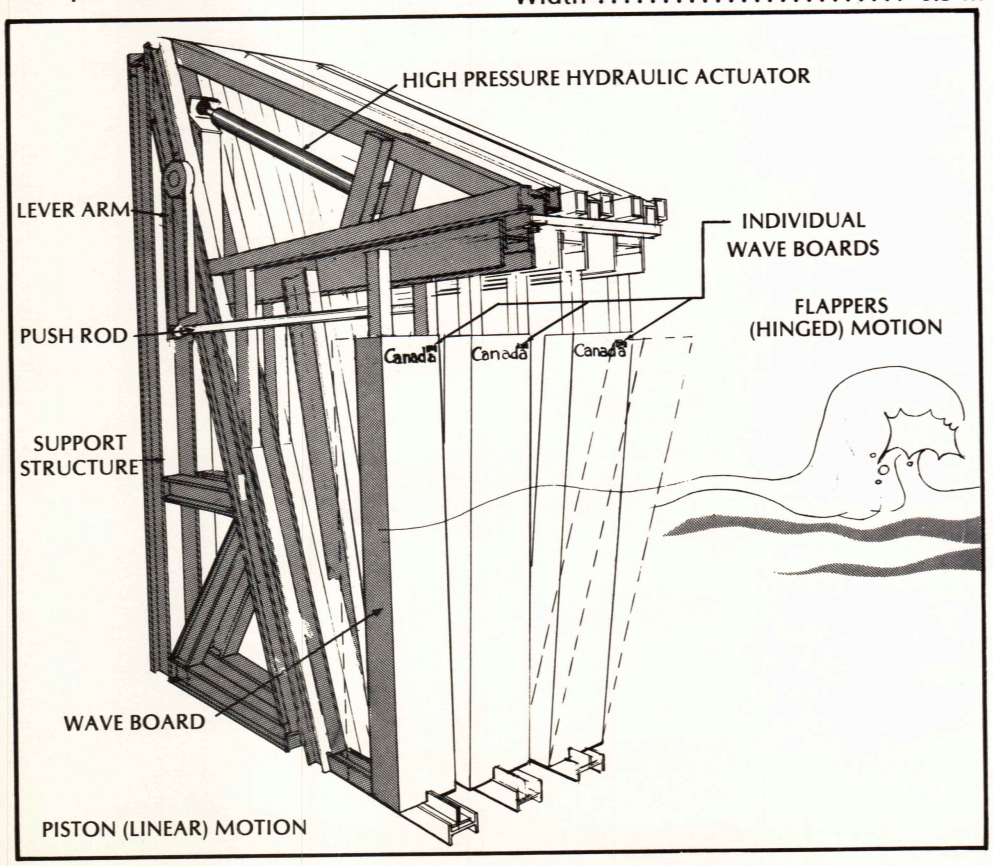
Each wave board utilizes a single actuator for combined operation of flapper and piston motions.

Support Structure

Each WM.5S is modular with four wave boards. Modules may be attached to a tank wall or, with additional ballast, may be arranged in a free standing configuration.

Module Dimensions:

Height ..... 4.0 m
Width ..... 2.0 m
Weight ..... 4,500 kg



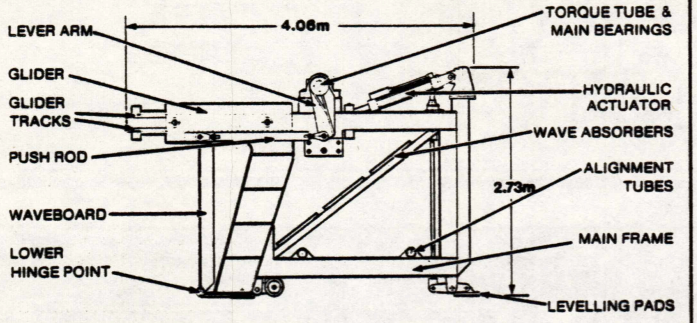
Davis Engineering
Consulting Engineers

For further information upon the Davis WM.5S, write or telephone:

W.R. Davis Engineering Limited,
1481 Cyrville Road, Ottawa,
Ontario, Canada, K1B 3L7

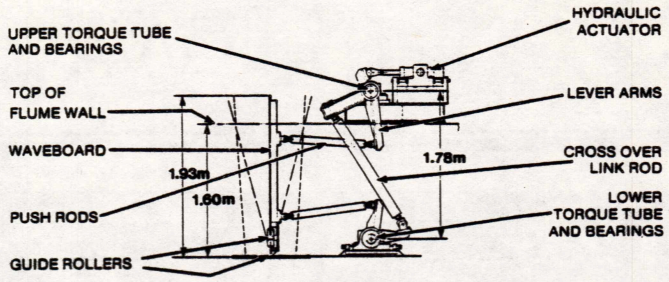
Phone: 1 613 746 3760
Telex: 053 3862

WAVE GENERATOR (SINGLE TORQUE TUBE)
WM 15



WAVEBOARD : 3.75m WIDE X 1.8m HIGH
PISTON MODE : ± 0.4m
FLAPPER MODE : ± 15°
COMBINATION ± 0.4m TOP
PISTON / FLAPPER : ± 0.3m BOTTOM

WAVE GENERATOR (DOUBLE TORQUE TUBE)
WM 3.01



WAVEBOARD : 3.01m WIDE X 1.9m HIGH
FLAPPER MODE : ± 15°
COMBINATION ± 0.4m TOP
PISTON / FLAPPER : ± 0.3m BOTTOM

lation of these forces, which constitute the machine design loading.

The mechanical support structure configuration is then optimized using a comprehensive "Stardyne" finite element computer model. A typical model is used to generate member stresses and structure deformations under design loading, as well as to perform a complete modal vibration analysis. With this approach, maximum rigidity can be obtained with minimum structural weight.

A mathematical transfer function is also developed between the input drive displacement and wave board output displacement. With this information, the drive linkage kinematics can be arranged to provide maximum linearity for the production of smooth waves.

Davis Engineering involvement extends beyond the design and development stages. Machines are fabricated in the 10,000 sq. ft. in-house shop and laboratory facility, and installed on location at the test facility. Machine set-up and maintenance, following installation, also reinforce customer satisfaction.

DAVIS ENGINEERING WAVE GENERATOR FEATURES

Naturally, a hydraulics laboratory or marine test facility wishes to operate the wave generating system best suited to its specific needs. A deep-water vessel facility or stability tank for example will require the generation of "deep water waves", whereas a coastal engineering facility deals mostly with shallow to intermediate water waves. The wave depth distinction relates to the fluid particle motions of the waves and to the degree in which the wave is influenced by the ocean floor. Shallow water waves are dominated by the horizontal particle velocity, with surface particle movement much the same as particle movement near the floor. Deep water wave particles on the other hand, possess near circular orbits, with amplitudes diminishing with distance from the surface. These facts, related to the generation of waves, mean that deep water waves can be best created by a flapper board motion and shallow waves with a piston motion.

The nature of testing may require the production of prescribed irregular (random) waves or regular wave patterns. The properly-matched wave generating system will produce waves of wave length and height consistent with the size of the tank and test model.

Davis Engineering is familiar with the varying needs of hydraulic test facilities and is in a unique position to supply the customer with an existing design or a custom designed system.

Two examples of Davis wave generators are shown above. The waveboards are powered by linear hydraulic actuators. Drive linkage configurations can be selected to provide pure piston motion, pure flapper motion, or combination of both. With a dual mode linkage, by repositioning one linkage connection, the user not only has the option of pure piston or flapper modes, but also combination modes of desired piston to flapper ratios. The combination modes afford the operator an extended frequency range capability.

Wave heights ranging from 0.04 to 0.85 m are attainable with periods from 0.4 to 6.0 s. The generation of both regular waves as well as random waves of specified characteristics is possible.

A cooperative agreement with MTS Systems Corporation, U.S.A., a world leader in the manufacture of electro hydraulic test equipment, has led to the design of the control and hydraulic systems for the wave generating units. The use of a dedicated computer to control waveboard motion, ensures the production of wave forms with a low level of total harmonic distortion coupled with a high level of repeatability. Hybrid digital/analog servo controllers provide flexibility in the allocation of processing tasks through a hierarchy of digital processes. Feedback control signals can be provided by waveboard displacement sensors and wave height probes.

Fabrication materials and components are judiciously chosen in light of the harsh corrosive and dynamic environment. The machines are of steel construction with many stainless steel components. Full epoxy paint treatments are utilized on non stainless steel components.

The wave machines can be mounted on a test basin wall or placed free-standing and ballasted on the basin floor. If wall-mounted, the added capability of vertically indexing the machines to create varying water depths, is available. Free-standing machines feature castors which enable orientation to accommodate the test model.

With the introduction of the WM.5S, Davis Engineering is providing technology never before available.

The design of this "second generation" segmented machine permits the generation of short-crested waves. The machine also has the capability of making waves at angles other than normal to the basin wall. A +/− 60° directional range is accomplished by actuating the segments out of phase in a "serpentine" motion.

Davis Engineering
Consulting Engineers

For further information, the interested reader is urged to contact:
Davis Engineering Limited,
1481 Cyrville Road,
Ottawa, Ontario Canada K1B 3L7
Phone: 1(613)748-5500 Telex: 053 3862

Wave-generating machine may help make oil rigs safer

OTTAWA (CP) — An advanced technology company hopes to rock international markets with a wave-generating machine developed with the assistance of the National Research Council (NRC).

The computer-assisted machines, unveiled earlier this week, will be capable of simulating the complex and frequently dangerous combinations of waves that can threaten shipping, harbors and oil rigs during severe storms, said Roland Davis, president of Davis Engineering Ltd.

A prototype of the machine, developed with the assistance of federal grants, was given a dry run in the factory by federal Supply and Services Minister Charles Lapointe.

The machine could generate international sales of $45 million during the next decade, Lapointe said.

By accurately simulating storm conditions in test pools containing scale models, it is hoped such tragedies as the sinking on Feb. 15, 1982, of the drill rig Ocean Ranger can be prevented, said Joe Ploeg, head of the NRC hydraulics laboratory. The NRC collaborated with Ottawa-based Davis Engineering in developing the prototype.

The Ocean Ranger sank about 180 nautical miles southeast of St. John's, Nfld., killing 84 men.

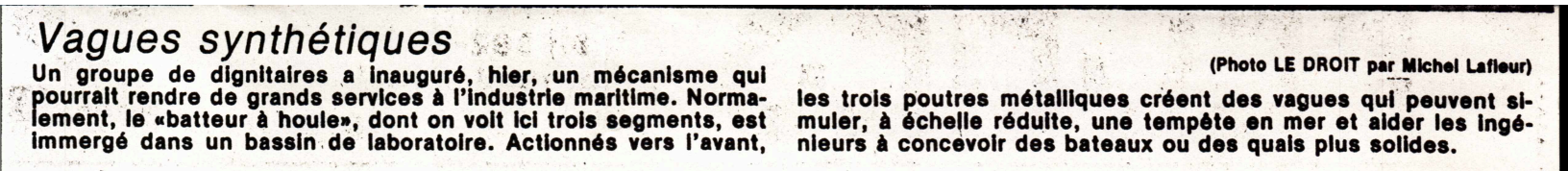
The federal research council now is testing a three-metre high scale model of the Ocean Ranger in its Ottawa wave basin but its current generating machines can't reproduce the complex conditions of that tragic storm, Ploeg said.

The new machine will use one hundred or more hydraulic-powered blades working together to churn the water to the desired condition. The machine will be driven by a computer programmed by the research council based on its research of wave characteristics.

Davis said the NRC is on the verge of signing a contract with his company to supply two such wave generators, one for the council's Ottawa laboratories and the second for the council's Arctic Vessel and Marine Research Institute under construction in St. John's.


Canada

Vagues synthétiques



(Photo LE DROIT par Michel Lafleur)

Un groupe de dignitaires a inauguré, hier, un mécanisme qui pourrait rendre de grands services à l'industrie maritime. Normalement, le «batteur à houle», dont on voit ici trois segments, est immergé dans un bassin de laboratoire. Actionnés vers l'avant, les trois poutres métalliques créent des vagues qui peuvent simuler, à échelle réduite, une tempête en mer et aider les ingénieurs à concevoir des bateaux ou des quais plus solides.

• Un «batteur à houle»

La mer en laboratoire

par Pierre Ouimet

GLOUCESTER — Chaque année, il se dépense, dans le monde entier, des millions de dollars pour réparer les dégâts causés aux constructions maritimes par les forces considérables libérées par les océans. En d'autres cas, on tente d'élucider le mystère qui a fait basculer une plate-forme de forage comme l'Ocean Ranger.

Or, le ministre des Approvisionnements et Services, M. Charles Lapointe, a présenté, hier, une nouvelle invention canadienne qui permettra, espère-t-on, de construire des structures maritimes plus sécuritaires et plus efficaces.

Il s'agit d'un «batteur à houle» (wave maker) qui sert à reproduire à échelle réduite, dans des bassins spécialement aménagés, les conditions que doivent affronter tous les bateaux, les plates-formes, les brise-lames et les quais.

L'appareil présenté hier, était un prototype de «deuxième génération», mis au point par la Davis Engineering Ltd, du chemin Cyrville, sous licence du Conseil national de recherches du Canada.

Le projet de mise au point a coûté $285,000, prélevés sur le Fonds fédéral d'expansion des entreprises.

M. Earl H. Dudgeon, directeur de la division de génie mécanique du CNRC a déclaré, hier, au cours de la cérémonie de présentation, qu'il s'agit d'un appareil «unique au monde», qui place la technologie canadienne au premier rang, dans le domaine.

Présentement, au laboratoire d'hydraulique du CNRC, a-t-il dit, les chercheurs se servent d'un batteur à houle qui ne produit qu'une seule sorte de vagues parce que ces dernières sont créées par un seul grand panneau solide d'une trentaine de pieds de longueur.

Or, le nouvel appareil est composé d'une série de poutres métalliques placées côte-à-côte, qui peuvent être actionnées individuellement, sous le contrôle d'un ordinateur.

Le nouveau batteur permet de reproduire des vagues multidirectionnelles, le tout pour reproduire le plus fidèlement possible les conditions qui surviennent durant les tempêtes.

Le prototype présenté hier était composé de trois segments, chacun actionné par un appareil hydraulique de 5,500 livres de poussée.

En novembre, le CNRC envisage d'accorder un contrat d'environ $4 millions pour installer 100 segments de ce genre autour du bassin de son laboratoire d'Ottawa, ainsi que 200 segments au bassin de l'Institut de recherches maritimes et des navires arctiques à St-Jean, Terre-Neuve.

Jim Lougheed, vice-président de la Davis Engineering, a déclaré que son entreprise va tenter d'obtenir ce contrat, forte de l'expertise qu'elle a acquise dans ce projet de développement et de ses 55 employés.

On ne retrouvera sans doute pas ce genre d'appareil partout sur le globe, mais la compagnie estime qu'elle pourra effectuer des ventes d'environ $45 millions au cours des 10 prochaines années.

M. Lougheed a dit qu'il se dessine déjà quelques possibilités du côté des Forces armées américaines (U.S. Corps of Engineers) et d'intérêts hollandais.

Le prototype de batteur à houle a aussi été mis au point avec la collaboration d'une entreprise américaine spécialisée dans ce domaine, la MTS Systems Corporation, qui a fourni surtout l'expertise électronique.

MEMO

To: All DE Staff

Update on Ministerial Visit, August 16, 1983

Due to Friday's Cabinet changes, D.E. will now be hosting the first public appearance of the Hon. Charles Lapointe, as Minister, Supply and Services Canada.

Also attending will be Dr. Ross Pottie, V.P. (Regional Labs) NRC (for Dr. Kerwin), Hon. Jean-Luc Pepin, our Federal MP, Mr. R.W. McQuarrie Q.C., our Provincial MP, Mr. Fred Barrett, Mayor of Gloucester, and many other dignitaries and associates.

I have attached an agenda for this event, and many of you will be specifically involved with one or more items, such as directing guests to the shop area. Two points for all to note are:

a) Parking - to keep it as clear as possible, we are asking all employees to park as far to the back as possible (Eric is looking after this), and
b) Office Area - since we will be invaded with guests, please ensure your work area is tidy.

Please see me today if there are items needing further attention that you notice.

Jim Lougheed

Davis Engineering
Consulting Engineers

AGENDA

Launching Ceremony - August 16, 1983

10:00 a.m.	Arrival of Minister's Party
10:05 - 10:45	Discussions between DE and Minister in Boardroom
10:15	Guests begin arriving
10:45	Officials and DE Executive move to Plant
10:50	Welcome - Mr. W.R. Davis
10:55	Dr. Ross Pottie, Vice-President, (Regional Laboratories) National Research Council
11:00	Hon. C. Lapointe, Minister of Supply and Services Canada
11:05	Wave Generator to be started by Mr. Lapointe
11:10	Guests invited to view Plant and obtain further refreshments
11:30	Ministerial Party departs DE

W.R. Davis Engineering Limited 1481 Cyrville Road, Ottawa, K1B 3L7 (613) 746-3760
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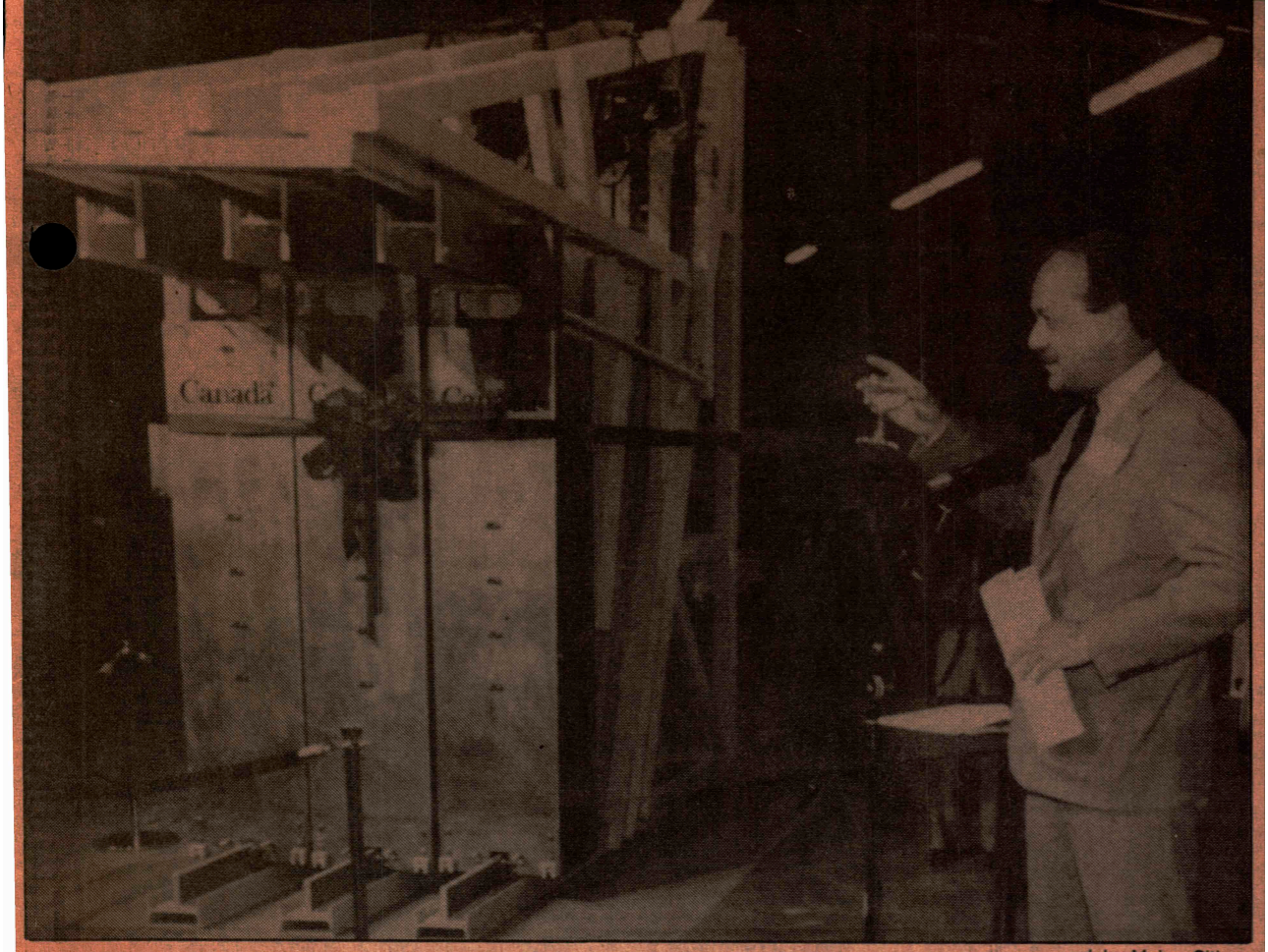

— John Major, Citizen

Supply and Services Minister Charles Lapointe (at microphone) toasts wave maker

Making waves looks profitable for Gloucester research firm

By Doug Yonson
Citizen staff writer

A willingness to get involved in a totally unknown technology four years ago is beginning to pay off for Davis Engineering Ltd.

The Gloucester firm, which specializes in contract research and development and creation of prototypes, delivered a 4.5-tonne, four-metre-high serpentine wave generator to the National Research Council Tuesday. If, as expected, NRC tests prove the success of the product, Davis will get the $4-million contract to produce 100 more of the devices and will have a springboard into millions of dollars in export sales to research institutes in marine nations around the world.

The NRC conducts, in its hydraulic labs, research into wave action with applications in marine transport, harbors and off-shore oil drilling. About four years ago, it had designed a wave generator to assist in the work and approached a number of private engineering firms to have one

but learning about new technologies is the bread and butter of its contract research and development arm, "and we specialize in combining technologies — in this case mechanical engineering and hydraulics — to meet needs".

It made one wave generator for the NRC, now being used to study the *Ocean Ranger* oil rig disaster, another for Ontario Hydro, and about last Christmas was awarded the $300,000 contract to construct the prototype, delivered Tuesday, for a wave generator that the NRC believes far exceeds the capacities of competing products made in Britain and Denmark.

The generator consists of linked vertical boards individually controlled by a microcomputer. Each arm moves at different speeds, amplitudes, with different crests; there are eight parameters in all. The boards move back and forth in test basins to simulate waves for testing vessels.

However, unique among world products, the Davis machine, de-

Davis says he hopes that among the 20 countries doing wave research his firm can get 40 per cent of the estimated market over the next ten years. If so, that would mean, he says, $45 million in sales and 400 person-years of employment.

The NRC contributed $10,000 seed money to the cost of the prototype, and the remaining $285,000 was paid by the Source Development Fund, a program by the department of supply and services to allow Canadian companies to gain expertise in major technologies with public and private sector markets.

The NRC is committed to Davis for the follow-up contract if the prototype works properly, and will use 100 of the individual arms at its Ottawa lab and the other 200 at its Arctic Vessel and Marine Research Institute under construction in St. John's.

Davis began his firm in 1975 as a one-man engineering consultant. It now employs 50 and in addi-

Making waves profitable

By Barbara Crook
Citizen staff writer

Making waves is helping an Ottawa engineering firm cruise to world prominence in high-technology research and development.

W. R. Davis Engineering Ltd. has just signed an $800,000 contract with MTS Systems Corp. of Minneapolis, Minn. to design and install a wavemaker, also known as a wave generator, for studying the effects of various ocean conditions on Arctic ships.

MTS is the prime contractor for the National Research Council's new Arctic Vessel and Marine Research Institute being built in St. John's, Nfld., where the wave generator will be used.

"This contract really helps establish us," says founder and president Roland Davis.

"MTS is one of the world leaders in wave generator technology, and this could help us become a world leader as well."

Wave tanks like the NRC's new one help engineers design safer and more efficient ocean vessels and semi-submersible structures, such as offshore drilling rigs.

In the same way a wind tunnel is used to see how buildings will react to wind of varying speeds and intensities, a wave tank tests the strength and movement of vessels in different "sea states."

in St. John's is about 12 metres wide, 200 metres long and five metres deep. Scale models of different types of vessels are towed through the tank and subjected to waves of different heights, angles and intensity.

Engineers then measure how much stress is put on the model under different wave conditions, as well as how much the model vibrates or changes course because of the waves. They use these results to design safer, more stable vessels.

The Davis wavemaker is a steel plate, 12 metres wide and five metres high, hinged horizontally so it can make a flapping motion.

It's placed at one end of the tank, and generates waves of different types and heights according to a computer-generated schedule.

Davis Engineering has already designed and built a wavemaker for Ontario Hydro and several for the NRC, including one used to figure out what went wrong with the *Ocean Ranger*, which sank in the North Atlantic off Newfoundland two years ago, killing 84 crew members.

It has teamed with MTS to design and make a wavemaker for the People's Republic of China, and is working on a new type of wave generator that works with a series of vertical "fingers" to create a wider range of wave angles and heights.

The company also does research and development in mechanical and electronic engineering for several federal government departments, including the Department of National Defence.

The eight-year-old company has 60 employees at its Ottawa headquarters, as well as a small office in Vancouver. Davis expects 1984 revenue to be at least $3 million.