NEWSLETTER NUMBER 10

JULY, 1980

FORCE PLATFORM GROUP

INTERNATIONAL SOCIETY OF BIOMECHANICS

Group Chairperson	Howard Payne Department of Physical Education, University of Birmingham, P.O. Box 363, Birmingham B15 2TT, England.
Newsletter Edited by	Barry D. Wilson (Secretary) Department of Human Movement Studies, University of Queensland, St. Lucia, Brisbane, Australia. 4067

(The Newsletter is circulated free to members of the Force Platform Group. Membership enquiries to the Secretary).

Contents

THE FORCE PLATFORM GROUP OF THE I.S.B.

The Group first formed in 1973 at the Fourth International Seminar on Biomechanics at the Pennsylvania State University, U.S.A. with an ad hoc committee of Peter Cavanagh (U.S.A.) and Don Grieve (England). Howard Payne (England) became 'catalogue editor' and produced two editions of "A catalogue of force platforms used in biomechanics research".

At the 1977 Sixth International Congress of Biomechanics at the August Krogh Institute, Copenhagen, Denmark, the Group re-formed itself, and elected Howard Payne as chairperson with Barry Wilson as secretary.

A biannual newsletter is produced by the Group and is sent to all members, who are asked to pay a US $6 subscription to cover the costs of producing and mailing the newsletter.

The biannual newsletter was initiated with the following objectives:

(a) To provide a bibliographic service to Group members on a regular basis.

(b) To publish original articles on topics related to force measurement in human biomechanics.

(c) To provide a forum for questions and answers on related subjects.

In this 'Message' in the Newsletter No. 1 the Chairperson urged: "Firstly, please let the editor of the newsletter have any ideas that you might generate concerning material to be included in future editions. The newsletter is a far stronger means of communication than one meeting of the Group every two years, and in such a small group, we shall need input from almost every member. Secondly, if you are aware of force platform users who are not members of our group, please encourage them to get in touch with us so that we can benefit from their input".

Editor's Note

This issue has been delayed due to a lack of submitted papers. Membership interest is high in the areas of platform design and applications. Please submit short papers or notes.

Back issues (Xerox copies) of the Newsletters 1-8 are available at a cost of $2.00 per issue. Airmail delivery from Australia is an additional $2.00 per issue (delivery time would be approximately 1 month from receipt of order).

A number of letters have been received. Details of these are included in the "Additions to the Force Platform Register" and in the "Additions to the Bibliography".

More contributions to the Newsletter are invited. Papers submitted to the Newsletter should be in a form suitable for publication with a maximum of 8 pages, in English, typed double space space with art work as black on white line drawings or photographic prints of black on white drawings of 3½" x 5" size.

Details concerning (1) the problem, (2) the platform, (3) the peripherals, and (4) how the platform can aid in solving the problem, would be appropriate for submission. Editorial changes will be minimal and should not require correspondence between the author and editor before publication. Papers should be submitted to the Newsletter editor by December 1 and June 1 for the January and July Newsletters respectively.

Finally, to those persons who have contributed to this Newsletter, thank you.

Barry D. Wilson

ADDITIONS TO THE FORCE PLATFORM REGISTER

Professor J.W. Barany,
School of Industrial Engineering,
Purdue University,
West Lafayette, IN 47907.

Aluminium - 6 steel cantilever beams 24" x 24"
LVDT's
Beckman Dynograph/Data General Minicomputer

Cameras

Human Gait

E.M. Hennig,
Biomechanics Laboratory,
Ostendstr.62
6000 Frankfurt 1/West Germany.

Capacitive multicomponent platform and Kistler platform.
32cm x 64cm for a 2048 element element mat
40cm x 60cm Kistler
UV recorder, Scope, computer

High speed and light pulse photography, ultrasonic velocity meter

Sports shoe investigation

Professor G.R. Bennott
Department D'Education Physique,
Universite Laval (Peps)
Quebec G1K 7P4,
CANADA.

Kistler 9261A
Regular Kistler Transducer
40cm x 60cm
Recorder - Nova 1200 - Ampex analog tape Fr 1300

Photisonic Camera (16mm 1P); H.P. And Visicorder 6 channel recorder for E.M.G.

X-C Skiing, Running (sprint - distance)

Professor R.H. Rozendal,
Department of Physical Education,
Free University,
Van der Boechorststraat 7,
P.O. Box 7161, AMSTERDAM,
The Netherlands.

Kisler, 60cm x 40cm
Piezo electric elements
Philips/ADC to microcomputer

Goniometers

Sports and pathological gait analyses

Dr. Steven L. Sauter,
Department of Preventive Medicine,
University of Wisconsin,
504 N, Walnut Street,
MADISON, Wl 53706.

our own construction (orthogonal I-Beams)
strain guage
18' x 18'
Digital Equipment Corporation 11/34A computer

x - y recorder, Oscillographs

behavioral toxicology

Professor Walter Schröder,
Fachbereich Sportwissenschaft Univ. Hamburg,
Molerstraße 10
D 2000 Hamburg 13 Bundesrepublik Deutschland

Working with DMS at Rowing orlocks

Sports techniques

Mr. Dave Sanderson,
Cumberland College of Health Sciences,
P.O. Box 170,
Lidcombe. N.S.W. 2141.
Australia

Kistler 9281 All
3 5001
Metal
FM Tape (Racal), on line PDP 11, C.R.O.

EMG (Medelec), Polgon, Locam, PDP11/10

Gait analysis for the disabled and for the disabled athlete

ADDITIONS TO THE BIBLIOGRAPHY

Hennig, E., 1980: Application of ultrasonic velocity measurement and capacitive pressure distribution measurement in gait analysis., Vortrag beim Kongress der "American Society of Biomechanics" in Burlington/Vermont, Oktober 1980.

Hennig, E., Albert, H. and U. Aisslinger, 1978: Messverfahren zur Erfassung von Vertikalkraeften and zeitabhaengigen Druckverteilungen, Orthopaedie-Technik, Heft 8/1978, S. 93 - 97. Vortrag beim Kongress "Orthopaedie-Technik 1978, Trier.

Hennig, E. und P. Cavanagh, 1980: High resolution pressure distribut -ion measurements in sport-shoes by piezoelectric transducers, Vortrag beim Kongress "Human Locomotion", London - Ontario - Kanada., Oktober 1980.

Hennig, E. und H. Habermann jun., 1979: Druckverteilung in Prothesenschaeften Vortrag beim Kongress "Orthopaedie-Technik 1979", Nuernberg, Mai 1979 Orthopaedie - Technik, Heft 1/ 1980, S. 1 - 4.

Hennig, E. und K. Nicol, 1978: Registration methods for time-dependent pressure distribution measurements with mats working as capacitors, in Asmussen, E. und K. Joergensen (Hrsg.): Biomechanics Vl-A, Baltimore, S. 361 - 367. Vortrag beim Biomechanik-Kongress, 1977, in Kopenhagen/Daenemark.

Hennig, E. und K. Nicol, 1979: Beruehrungsloses, akustisches Geschwindigkeitsmessverfahren and kapagitives Kraftmessverfahren zur Erfassung biomechanischer Groessen in der Ganganalyse, Druck des Oskar-Helene Heims, Berlin, S. 241 - 257. Vortrag beim "Pauwels-Symposium, Berlin, Januar 1979.

Nicol, K. und E. Hennig, 1976: Time-dependent method for measuring force distribution using a flexible mat as a capacitor, in Komi, P.V. (Hrsg.) : Biomechanics V-B, Baltimore, S. 433 - 440. Vortrag beim Biomechanik-Kongress, 1975, in Jyvaeskylae/Finnland.

Nicol, K. und E. Hennig, 1978: Measurement of pressure distribution by means of a flexible, large-surface mat, in Asmussen, E. und K. Joergensen (Hrsg.): Vortrag beim Biomechanik-Kongress, 1977, in Kopenhagen/Daenemark.

CONFERENCES.

VIII INTERNATIONAL CONGRESS OF BIOMECHANICS

JULY 20th to 24th, 1981.

NAGOYA, JAPAN.

GENERAL TOPICS

- General Biomechanics
- Human Engineering Biomechanics
- Medical Biomechanics
- Sports Biomechanics
- Biomechanics of Rehabilitation
- Research Methodology of Biomechanics

DEADLINES

Febuary 1, 1981 : Receipt of Application Forms and Abstracts

March 1, 1981 : Acceptance of Abstracts Submitted

May 1, 1981 : Final Registration Hotel Accomodation

June 1, 1981 : Receipt of Manuscripts

The presentation will be done orally. Congress language English

VIIIth I.C.B. ORGANIZING COMMITTEE

Chairman : Prof. H. Matsui (Nagoya Univ.)

Vice Chairman : Associ. Prof. M. Miyashita (Univ. Tokyo)

Secretary General: Dr. K. Kobayashi (Nagoya Univ.)

Mailing Address:

Research Center of Health, Physical Fitness and Sports,
Nagoya University, Furo-cho,
Chikusa-ku, Nagoya, JAPAN.

VI INTERNATIONAL SYMPOSIUM OF POSTUROGRAPHY

September 14th to 20th, 1981.

Kyoto, Japan.

The international Society of posturography (ISP) has been in existance since 1969. The members of this society nearly all work with force platforms.

For information write to:

Dr. I. Matsuoka,
Dept. of Otolaryngolgy,
Faculty of Medicine,
Kyoto University,
Sakyo-ku, Kyoto 606,
JAPAN.

MOUNTING A FORCE PLATFORM IN A HIGH RISE BUILDING.

by

Bahaa B. Seedhom

Department of Rheumatism Research,
University of Leeds,
LEEDS 2.

INTRODUCTION

The best location for a force platform is on the ground floor of a building, where the platform can be mounted on a large concrete block that is totally isolated from the foundations of the building. Thus the output signal from the force platform should not be affected by vibrations generated either by traffic or machinery in the same building. It is unfortunate if the force platform has to be accommodated on a higher floor.

This paper relates the problems encountered in mounting two force platforms on the first floor in the Kinesiology laboratory of the Rheumatism Research Unit at Leeds. Being a case report, this contribution must be of a limited usefulness, in that it is describing the solution to a problem (or more accurately, a predicament) that varies considerably from one case to another.

THE ACCOMMODATION

The room had the dimensions shown in Figure 1. Fortunately, there were, in a most strategic position, two walls, 2.05 metres apart, perpendicular to the outer shell wall of the building. The walk-way was to be adjacent to this wall, and hence the problem crystallised as one of designing two structures, one for each force platform, spanning the two walls.

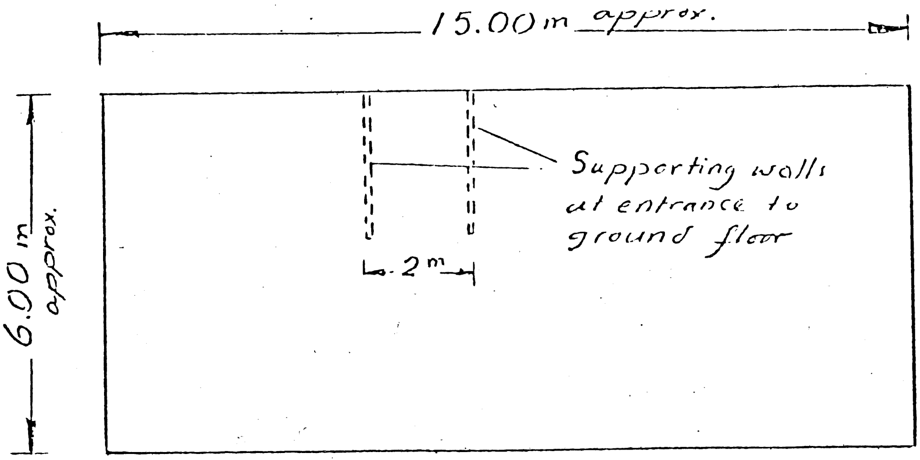


Fig. 1

DESIGN OF THE STRUCTURE AND THE NATURAL FREQUENCY OF THE SYSTEM.

The structure had to be light enough, and of such stiffness as to have a sufficiently high natural frequency. Strength was not the more important criterion in the design of the structures, as this could be easily achieved. Discussion with experts led to the conclusion that the natural frequency had to be in excess of 100 Hz.

To predict the natural frequency of the system, the latter was approximated to the simple model shown in Figure 2 in which the structure was represented by a simply supported beam with the load at the centre. The load here would be that due to the combined masses of the structure and the force platform.

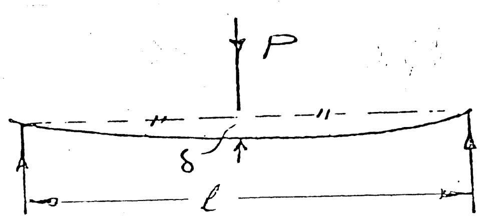


Fig. 2

The deflection of the beam would be given by the well-known formula:-

$$\delta = \frac{P\ell^3}{48EI}$$

where P is the load acting (N)

ℓ is the length of the beam between the supports (m)

E is the modulus of elasticity of the beam material (N/m^2)

I is the second moment of area of the cross-section of the beam (m^4)

Now this system has a stiffness which is defined as the load that is necessary to produce a unit deflection, that is,

$$K = \frac{P}{\delta}$$

where: K is the stiffness of the system

δ is the deflection of the beam, and

P is the load acting at the centre of the beam.

The natural frequency of the system is given by formula

$$f = \frac{1}{2\pi}\sqrt{\frac{K}{m}}$$

where m is the mass; in this case, the combined mass of the frame and the force platform.

Substituting for K in this last equation, we obtained

$$\text{natural frequency} = \frac{1}{2\pi}\sqrt{\frac{48E}{\ell^3}\frac{(I)}{(m)}}$$

Thus, the higher the value of I, and the lower the mass in the system, the higher will be its natural frequency.

The first design cousidered was to mount each platform on two channels which were connected at both sides by narrow plates welded at the top and the bottom, (see Fig. 3).

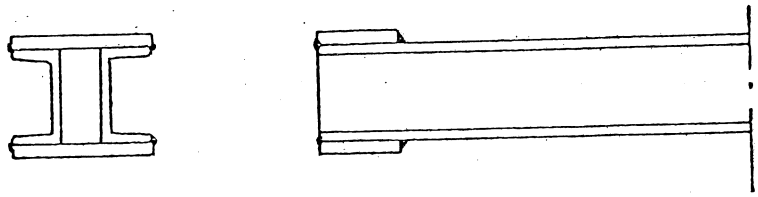


Fig. 3

The structure, which was basically two 20 cm channels side by side, yielded a natural frequency of 70 Hz in the vertical direction. Larger channels resulted in higher natural frequencies but the weight of the structure became considerably greater. What contributed to an increase in the weight of the structure was the requirement that the natural frequency in the lateral direction also had to be high. So the channels had to be approximately 50 cm apart, and in order to couple them, two steel plates, which were 12.5 mm thick, would have had to be welded along the whole length of the two channels to form a box-like structure, (see Fig. 4).

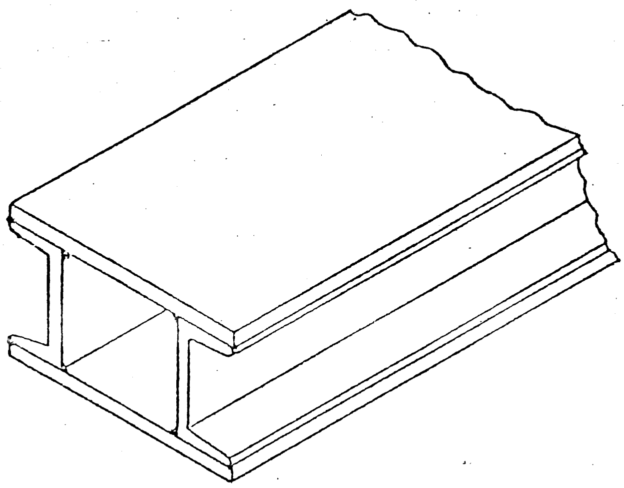


Fig. 4

Whilst a natural frequency of 160 Hz could be achieved with such a structure in the vertical direction, and a natural frequency in the lateral direction in excess of 160 Hz, the structure for each platform would have had a mass of 350 kg. Therefore, it was decided to make a welded frame instead, as shown in Figure 5.

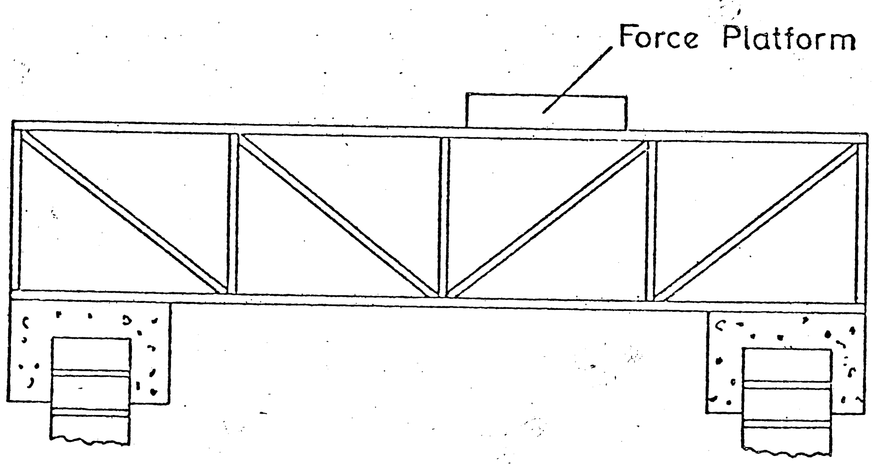


Fig. 5

All the members were made of the same channel section, which was 7.6 x 3.8 cm. This structure weighed 200 kg approximately. Experts on steel structures in the Department of Civil Engineering at Leeds University stated that the second moment of area of the structure should be based on the cross-sectional area of two of the four main horizontal members of the structure. (a being the cross-sectional area of the channel). In other words, $I = 2.A.h^2$ approximately rather than $4.A.h^2$. The predicted natural frequency of the system was approximately 140 Hz. The fact that the frame almost had a uniformly distributed mass meant that the deflection would be smaller, i.e.

the structure stiffer and consequently the ststem could have a slightly higher natural frequency than the predicted one.

The natural frequency was measured in three mutually orthoganal directions. It was found to have a value of 166 Hz in the vertical direction, and a value of 125 Hz in the direction of the long axis of the structure, but in the third direction, (the lateral), the natural frequency was only 66 Hz. Whilst this is much lower than the natural frequencies in the two other directions, it is still very much higher than the frequencies of the forces applied during the fastest activities likely to be studied. This is due to the cushioning effect of the fat pad on the human foot, and also due to the fact that during most activities the hip and the knee are very rarely in full extension, i.e. in a locked position, and this has a considerable cushioning effect, and so the frequencies of the forces arising at the foot-platform interface would be much lower than the lowest natural frequency of the system. There appeared to be no need for further stiffening of the frames. Each structure had a number of steel pads to which the mounting frames of the force platforms were to be bolted. The pads were first welded to the upper surface of the structure and then machined so that their surfaces were in the same plane in order not to cause distortion to the platform when mounted.

The mounting procedure of these structures also required careful consideration. Each structure was mounted on a concete block at each end. These concrete blocks were cast in situ on the wall, as follows. Each structure had two jacking screws at either end which rested on steel pads on the wall and which were surrounded by thin-walled plastic tubes. These screws
at either end which rested on steel pads on the wall and which

were surrounded by thin-walled plastic tubes. These screws were employed to adjust the levels of the pads on their upper surfaces so that they were in the same horizontal plane. After doing so, the four concrete blocks were cast, and after a week the jacking screws were turned so that the frames were lowered by the amount that the concrete had shrunk, thus transmitting their weights totally on the concrete blocks at either end. Then the frames were secured further to the blocks by four bolts each, two at each end. Details of the concrete blocks and fixation are depicted in Figure 6.

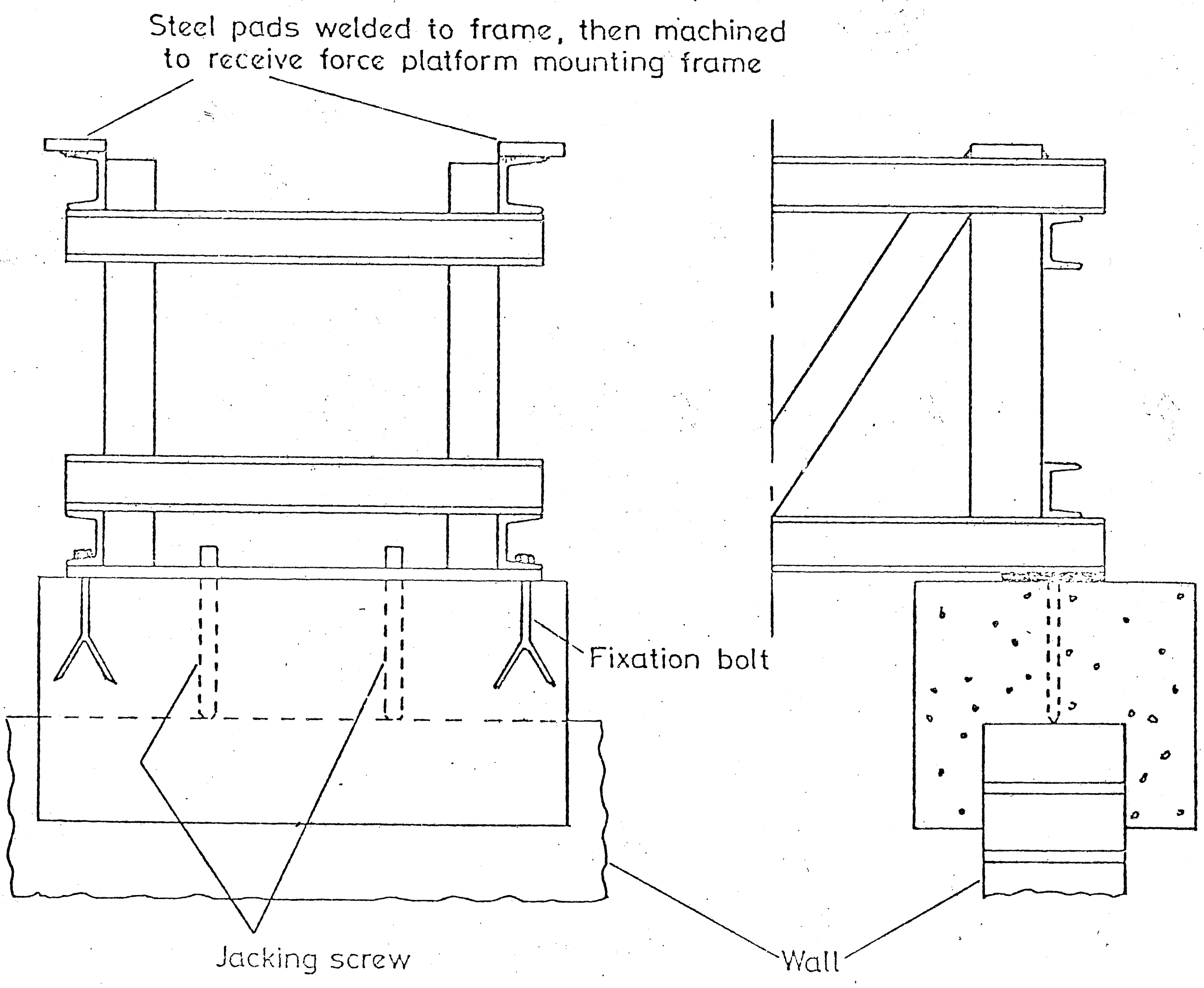


Fig. 6

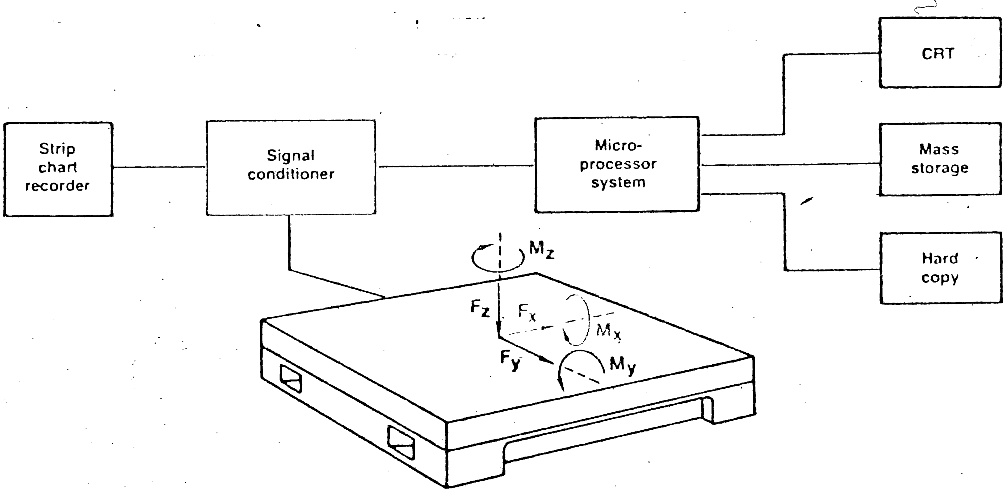
TECHNICAL NOTES.

AMTI 6-Component Biomechanical Platforms

SPECIFICATIONS*

	OR6-3	OR6-4
Range Fx, Fy, Fz lbf	±1200	±2400
Mx, My, Mz in-lbf	±4000	±8000
Overload Fx, Fy, Fz %	50	50
Crosstalk %	<2	<2
Resonant Frequency, Vert. (Hz)	400	560
Sensitivity $\frac{\mu \text{ volts}}{\text{volt-lbf}}$ Fx, y	.7	.3
Fz	.4	.2
$\frac{\mu \text{ volts}}{\text{volt-ftlb}}$ Mx, y	.6	.3
Mz	1.6	0.8
Temperature Range °F	0–200	0–200
Weight lb	60	60

*Subject to Modification



SIGNAL CONDITIONING One signal conditioner/amplifier is required for each force or torque signal desired. Existing customer instrumentation may be compatible with the AMTI platforms.

INFORMATION DISPLAY. Amplifier outputs may be directly displayed via a strip chart recorder for simple measurements. Where considerable data handling and reduction is required, signal processing can provide resolution of all forces and torques, force ratios, "signature" generation, and many other information formats.

Among other final display options available are CRT display, digital plotter and teleprinter.

MATERIALS OF CONSTRUCTION. The base and platform (20" x 18.25" x 3.25") are machined of corrosion resistant aluminum and are especially designed for high stiffness and light weight. The precision strain rings are of a high alloy steel, and the gauges are sealed for moisture protection. A gasket fitted between the platform and base adds further protection from dust and moisture for operation in varied environments.

ACCESSORIES

MODEL 2100A MULTICHANNEL SIGNAL CONDITIONER/AMPLIFIER

A complete 6channel biomechanics platform power supply and amplifying system including:

Model 2110A Power supply (1 unit)
Model 2120A Two-channel amplifiers (3 units)
Six-channel rack-mount case

- Fully adjustable and regulated bridge excitation on each channel; up to 12 VDC
- Continuously variable amplifier gain up to 2100
- Output 10 VDC or 100 mA, short-circuit-proof and current-limiting standard
- High stability with temperature and time
- Frequency response 5 kHz (-0.5 dB, 5%)

CABLES

Six low noise connecting cables for interfacing biomechanical platform to signal conditioners/amplifiers; each 10 ft. long.

SPECIALIZED PLATFORMS AVAILABLE

Transparent Top Plate
Higher Load Capability
High Sensitivities
T-Slotted Top Plate
Customized Platforms

ADVANCED MECHANICAL TECHNOLOGY INC.

141 California St.,
Newton, MA 02158
Phone: (617)964-2042
TWX:710-335-0406

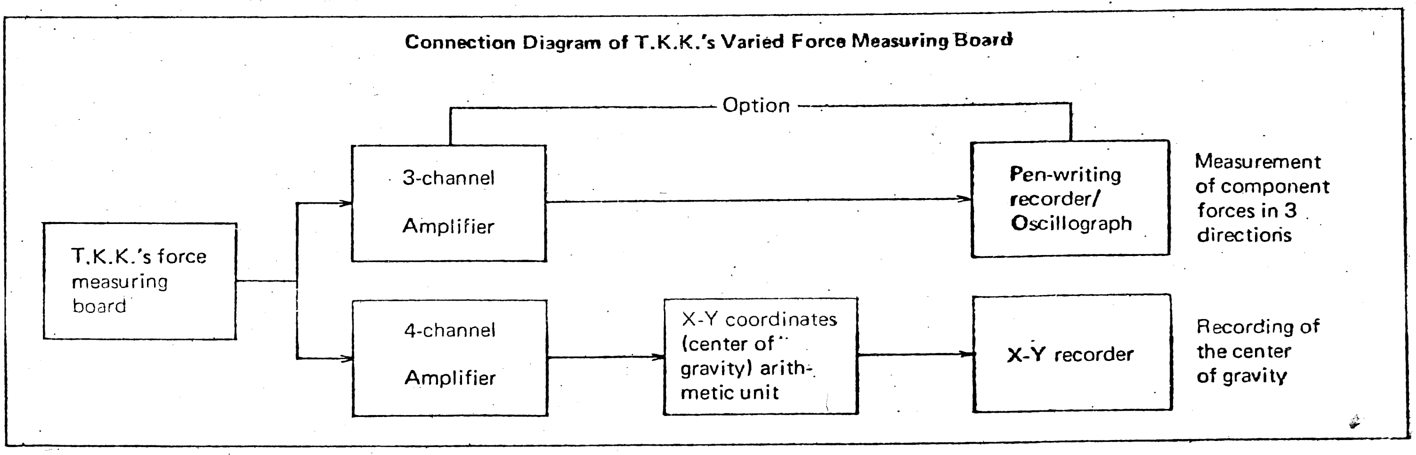
TAKEI DYNAMOMETER

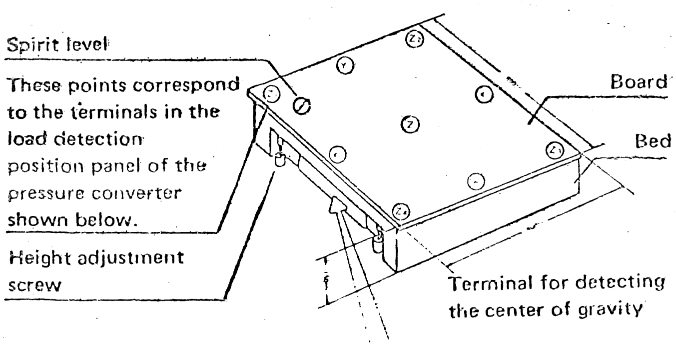
SPECIFICATIONS.

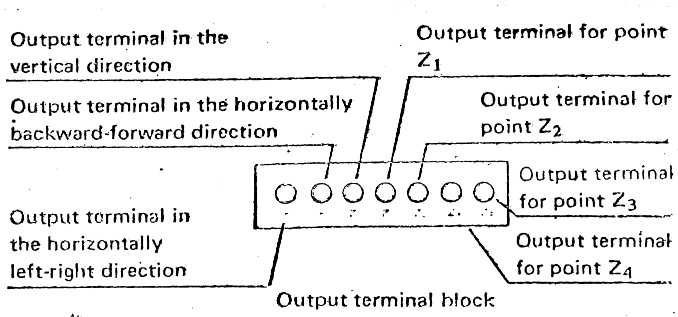
1. Range of measurement:
   Vertical direction
     Approx 500kg. (allowable overload of 150%)
   Horizontally left-right direction
     Approx 200kg. (allowable overload of 150%)
   Harizontally backward-forward direction
     Approx 200kg. (allowable overload of 150%)

2. Output voltage:
   Vertical direction
     Approx 0.8 mv/v 500kg.
   Horizontally left-right direction
     Approx. 0.4mv/v 200kg.
   Horizontally backward-forward direction
     Approx 0.4mv/v 200kg.
   Output at the center of gravity
     Approx 17mv/v 500kg.
   Natural frequency
     More than 100 Hz
   Range of service temperatures
     $-5^{o}C \sim 50^{o}C$

3. Dimensions and weight: 800W x 150H x 800 D mm
     Approx 69kg.(including connection cable)
   Care must be taken to avoid placing the instrument
     on an unstable floor.







ACCESSORIES

Amplifier (options):
T.K.K. 4-channel amplifier
Recorder (option):
Merculy lamp type
Visigraph 5L36 type (6ch)
Visigraph 5L36 type (photo)
Pen-writing Oscillograph

X-Y recorder (Option):
WX4402 type   Standard cartridge fiber-pen type
WX4403 type   Cartridge fiber-pen type with two pens

EXPORT AGENTS FOR TAKEI & COMPANY, Ltd.
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2-9-1, Nishishinbashi, Minato-Ku,
TOKYO.
Phone : (502)3401.

The Force Platform Group

International Society of Biomechanics

Subscriptions

Please complete and return this form with U.S.$6 (or equivalent), being subscription fee for 1981, to Barry Wilson,

Department of Human Movement Studies,
University of Queensland,
St. Lucia,
Brisbane,
Australia 4067.

If you wish you may send U.S.$12 for 1981 and 1982.

Name: ______________________________

Address: ______________________________

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Amount enclosed: ______________________________

Please make cheques payable to Barry Wilson, Force Platform Group, International Society of Biomechanics.

Force Platform Group. I.S.B.,
C/o Dept. of Human Movement Studies,
University of Queensland,
St. Lucia, Brisbane, 4067,
Australia.

Dear Colleague,

In the 4th Newsletter was included a register, or list of members and their research interests. In order to update this register would you allow me to publish brief details of your work. Please complete the questionnaire below and return to me as soon as possible:

1) Name ____

2) Title (Mr., Mrs., Ms., Dr., Prof., etc.)____________________

3) Address ____

____

____

4) Institution (if different to above) __________________________

____

____

5) Do you work with a force platform? Yes _______ No_______

6) If answer is NO please give reasons for your interest:-

____

____

7) Please give brief details of your platform or platforms

Type ______________________________

Transducers ________________________

Size of top surface ____________________

Recorder ___________________________

Other ______________________________

8) What auxiliary equipment do you use? (e.g. E.M.G., cameras, etc.)

____

9) What are the main lines of your research? (e.g. sports techniques, gait analysis, etc.) __________________________________

10) Please list any relevant publications by you which have not been included in Newsletters 1 and 2. (Attach additional sheets if necessary)

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Many thanks for your co-operation.

Barry D. Wilson,

Secretary, F.P.G.