



**INDIAN INSTITUTE OF TECHNOLOGY MADRAS**  
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V. Rajendran  
Assistant Registrar (Project Purchase)

Ref: CIE/13-14/210/MHRD/CVRM  
Date: 9<sup>th</sup> March, 2015

Tender No: CIE/ARUM/007/2015

**Due Date: 30.03.2015, 3:30pm**

Dear Sir/Madam,

On behalf of the Indian Institute of Technology Madras, offers are invited for the supply of "**Uniaxial Shake Table**" conforming to the specifications given in Annexure.

**Instructions to the Bidder**

- (i) **Preparation of Bids:** - The tenders should be submitted under two-bid system (i.e.) Technical bid and Financial bid.
- (ii) **Pre-bid meeting** – The pre-bid meeting is scheduled on 16<sup>th</sup> March 2015 at 11 A.M. in the meeting room of the Structural Engineering Laboratory. All the bidders MUST visit the site before the date of the Pre-Bid meeting and prepare a technical design, and present the design aspects (technical) of the solution they intend to bid at the pre-bid meeting.
- (iii) **Delivery of the tender:** - The tender shall be sent to the below-mentioned addresses either by post or by courier so as to reach our office before the due date and time specified in our Schedule. The offer/bid can also be dropped in the tender box on or before the due date and time specified in the schedule. The tender box is kept in the office of the "**Assistant Registrar, Project Purchase**" IC & SR Building 2<sup>nd</sup> floor, I.I.T. Madras, Chennai – 600 036.
- (iv) **Opening of the tender:** - The offer/Bids will be opened by a committee duly constituted for this purpose. The technical bids will be opened first and it will be examined by a technical committee which will decide the suitability of the bid as per our specifications and requirements. The bidders will be invited for opening of Technical bids. In respect of opening of financial bid, those bidders who are technically qualified only will be called for.
- (v) **Prices:** - The price should be quoted in Nett per unit (after breakup) and must include all packing and delivery charges to various Departments/Centres/Institutions. The offer/bid

should be exclusive of taxes and duties, which will be paid by the purchaser as applicable. However the percentage of tax & duties should be clearly indicated.

The price should be quoted without custom duty and excise duty, since I.I.T. Madras is exempt from payment of excise duty, and the custom duty will be paid at concessional rate against duty exemption certificate.

In case of import supply, the price should be quoted on EX-WORKS and CIP basis indicating the mode of shipment.

- (v) **Agency Commission:** - Agency commission, if any, will be paid to the Indian agents in Rupees on receipt of the equipment and after satisfactory installation. Agency Commission will not be paid in foreign currency under any circumstances. The details should be explicitly shown in Tender even in the case of 'Nil' commission. The tenderer should indicate the percentage of agency commission to be paid to the Indian agent. The foreign Principal should indicate about the percentage of payment and it should be included in the originally quoted basic price, if any.
- (vi) **Terms of Delivery:** - The item should be supplied to our various Departments/Institutions as per Purchase Order. In case of import supply, the item should be delivered at the cost of the supplier to our Institution. The Installation/Commissioning should be completed as specified in our important conditions.
- (vii) IIT Madras reserves the full right to accept / reject any tender at stage without assigning any reason.

Yours sincerely,



**V.RAJENDRAN**  
**ASSISTANT REGISTRAR**  
(Project Purchase)  
IC&SR, I.I.T. Madras

## SCHEDULE

### Important Conditions of the tender

1. The due date for the submission of the tender is **30.03.2015, 3:30pm**.
2. The offers / bids should be submitted in two bids systems (i.e.) Technical bid and Financial bid. The Technical bid should consist of all technical details / specifications only. The Financial bid should indicate item-wise price for each item and it should contain all Commercial Terms and Conditions including Taxes, transportation, packing & forwarding, installation, guarantee, payment terms, pricing terms etc. The Technical bid and Financial bid should be put in separate covers and sealed. Both the sealed covers should be put in a bigger cover. The Open Tender for supply of “ \_\_\_\_\_ ” should be written on the left side of the Outer bigger cover and sealed.
3. **EMD:** - EMD should be at 2% (two percent) of the tender value quoted by the bidder. The EMD should be included in the Financial bid which will not be opened for Technical evaluation. Enclosing the EMD in the Technical bid will automatically disqualify the tenderer. EMD should be in the form of DD in favour of “The Registrar, Indian Institute of Technology Madras” and payable at Chennai. The tender without EMD would be considered as UNRESPONSIVE and REJECTED. Photo/FAX copies of the Demand Draft/Banker’s pay orders will not be accepted. No interest will be paid for the EMD and the EMD (Bid Security) will be refunded to the successful bidder on receipt of Performance Security.
4. **Performance Security:-** The successful bidder should submit Performance Security for an amount of 5% of the value of the contract/supply. The Performance Security may be furnished in the form of an Account Payee DD, FD Receipt from the commercial bank, Bank Guarantee from any nationalized bank of India will be an acceptable.

**Only after submission of Performance Security, Purchase Order/Work Order will be released / L.C will be opened.**

**Performance Security in the form of Bank Guarantee:-** In case the successful bidder wishes to submit Performance Security in the form of Bank Guarantee, the Bank Guarantee should be routed through the Beneficiary Bank to the end user bank. Otherwise, the Indian Agent of the foreign vendor has to submit a Bank Guarantee from a Nationalized Bank of India.

The Bank Guarantee should remain valid for a period of sixty days beyond the date of completion of all contractual obligations of the supplier including the warranty obligations.

5. If an Indian agent is involved, the following documents must be enclosed:  
Foreign principal's proforma invoice indicating the commission payable to the Indian Agent and nature of after-sales service to be rendered by the Indian Agent.
  - ✓ Copy of the agency agreement with the foreign principal and the precise relationship between them and their mutual interest in the business.
  - ✓ The enlistment of the Indian agent with Director General of Supplies & Disposals under the Compulsory Registration Scheme of Ministry of Finance.
6. The offer/bids should be sent only for a machine that is available in the market and supplied to a number of customers. A list of customers in India and abroad with details must accompany the quotations. Quotations for a prototype machine will not be accepted.
7. Original catalogue (not any photocopy) of the quoted model duly signed by the principals must accompany the quotation in the Technical bid. No prices should ever be included in the Technical bid.
8. Documentary proof for the claimed position and reputation accuracies must be obtained from the principals and submitted along with the relevant pages of the standards.
9. Compliance or Confirmation report with reference to the specifications and other terms & conditions should also be obtained from the principal.
10. **Validity:** Validity of Quotation not less than 90 days from the due date of tender.
11. **Delivery Schedule:-** The tenderer should indicate clearly the time required for delivery of the item. In case there is any deviation in the delivery schedule, liquidated damages clause will be enforced or penalty for the delayed supply period will be levied.
12. **Risk Purchase Clause:-** In the event of failure of supply of the item/equipment within the stipulated delivery schedule, the purchaser has all the right to purchase the item/equipment from other sources on the total risk of the supplier under risk purchase clause.
13. **Payment:-** No Advance payment will be made for Indigenous purchase. However 90% Payment against Delivery and 10% after installation are agreed to wherever the installation is involved. In case of import supplies the payment will be made only through 100% Letter of Credit i.e. (90% payment will be released against shipping documents and 10% after successful installation wherever the installation is being done).
14. **Advance Payment:-** No advance payment is generally admissible. In case of specific percentage of advance payment is required, the Foreign Vendor has to submit a Bank Guarantee equal to the amount of advance payment and it should be routed through the

Beneficiary Bank to the end user Bank. Otherwise, the Indian Agent of the foreign vendor has to submit a Bank Guarantee through a Nationalized Bank of India.

15. **On-site Installation:** - The equipment or machinery has to be installed or commissioned by the successful bidder within 15 to 20 days from the date of receipt of the item at site of IIT Madras.
16. **Warranty/Guarantee:** - The offer should clearly specify the warranty or guarantee period for the machinery/equipment. Any extended warranty offered for the same has to be mentioned separately. (for more details please refer our Technical Specifications).
17. **Late offer:** - The offers received after the due date and time will not be considered. The Institute shall not be responsible for the late receipt of Tender on account of Postal, Courier or any other delay.
18. **Acceptance and Rejection:** - I.I.T. Madras has the right to accept the whole or any part of the Tender or portion of the quantity offered or reject it in full without assigning any reason.
19. **Do not quote the optional items or additional items unless otherwise mentioned in the Tender documents / Specifications.**
20. **Disputes and Jurisdiction:** - Any legal disputes arising out of any breach of contract pertaining to this tender shall be settled in the court of competent jurisdiction located within the city of Chennai in Tamil Nadu.
21. All Amendments, time extension, clarifications etc., will be uploaded on the website only and will not be published in newspapers. Bidders should regularly visit the above website to keep themselves updated. No extension in the bid due date/ time shall be considered on account of delay in receipt of any document by mail.

**Acknowledgement:-** It is hereby acknowledged that the tenderer has gone through all the conditions mentioned above and agrees to abide by them.

**SIGNATURE OF TENDERER  
ALONG WITH SEAL OF THE  
COMPANY WITH DATE**

Open Tender for Uniaxial Shake Table for Seismic Testing

Quotations are invited for Uniaxial Shake Table for Seismic Testing with seismic controller and hydraulic distribution system. The system should be particularly suited for investigation of models of historical masonry structures.

**TECHNICAL SPECIFICATIONS**

**1. GENERAL**

- 1.1. These specifications identify the minimum requirements for the Uniaxial Shake Table for Seismic Testing with seismic controller and hydraulic distribution system intended to be procured.
- 1.2. The system should be upgradable to a Biaxial Testing System in the future, with minimum alterations.
- 1.3. The system must have the capability for upgrade to a real-time hybrid simulation system. The supplier must provide evidence of such systems for at least 5 sites where they have supplied similar systems.
- 1.4. Only bids from suppliers who have provided 10 or more systems comparable in terms of the working principles, capacity and scope, and that are in working condition, with well-established maintenance and repair service team in India will be considered.
- 1.5. The quotation should contain the costs related to the second actuator and its commissioning.
- 1.6. The system should be compatible with the existing hydraulic distribution system for structural testing in the Laboratory, details of which can be provided on request.
- 1.7. The technical and financial offer must be valid for a period for 6 months.
- 1.8. Other components, not identified or specified, which are necessary for the system to meet required functionality are understood to be proposed and provided by supplier.
- 1.9. The supplier has to state clearly those aspects of the products that are not compliant to specifications listed here.
- 1.10. In the financial bid, costs of all components have to be provided separately.
- 1.11. The technical proposal should contain the following and should be placed in a separate envelope, and should not contain any financial information:
  - 1.11.1. Background of the company and the service offered in India for installation, maintenance and repair.

- 1.11.2. Duly-filled checklist for the technical specifications.
- 1.11.3. Details of comparable equipment supplied by the vendor in India, with contact details for verification and inspection.
- 1.11.4. Details of the spare parts and AMCs.

## **2. UNIAXIAL SHAKE TABLE FOR SEISMIC TESTING**

### **2.1. Uniaxial Shake Table - 3.0 m x 3.0 m: 1 No.**

- 2.1.1. Table size should be of 3.0 mx 3.0 m working area
- 2.1.2. Table should include a grid with 400 mm spacing of 64 (8 x 8) M24-3 threaded holes for specimen mounting plugs, with plugs included for each mounting hole
- 2.1.3. System should cater to a maximum specimen mass of 10,000 kg
- 2.1.4. System should cater to a maximum overturning moment of 30 meter tons
- 2.1.5. System should cater to a maximum height of 10,000 kg specimen center of gravity of 3m
- 2.1.6. System should cater to a maximum torsional moment of 10meter tons
- 2.1.7. System should cater to a maximum horizontal eccentricity of a 10,000 kg specimen of not less than 1m
- 2.1.8. System needs to operate in a frequency range of 0 - 50 Hz
- 2.1.9. System should provide a total dynamic displacement of 500 mm total (i.e. +/- 250 mm displacement)
- 2.1.10. System should cater to a maximum velocity of +/- 1.0 m/sec with maximum specimen mass
- 2.1.11. System should cater to a maximum velocity of +/- 1.4 m/sec with bare table
- 2.1.12. System should support a maximum acceleration with maximum specimen mass of not less than 1.1 g
- 2.1.13. System should support a maximum acceleration with zero mass of not less than 2.6 g
- 2.1.14. Table provided with linear guide bearing assemblies with protective bellows
- 2.1.15. Table provided with closed-housing DC accelerometer with +/- 8.0 g sensitivity
- 2.1.16. Base plate should be provided with 24 (40 mm) holes on a grid of 500 mm for attachment to the floor

### **2.2. Actuator Assembly for Shake Table: 1 No.**

- 2.2.1. Dynamic stroke not less than 508 mm
- 2.2.2. Static stroke not less than 610 mm
- 2.2.3. Force at 19 MPa: +/- 227 kN
- 2.2.4. Actuator must be provided with 51 mm cushions at each end
- 2.2.5. Servo-valve rated flow: 630 lpm
- 2.2.6. Should have differential pressure transducer
- 2.2.7. Include 3.8 L close-coupled accumulators on Pressure and Return
- 2.2.8. Should have mounting flange for direct mounting of actuator to the floor

**2.2.9. Swivel Base Assembly: 1 No.**

- 2.2.9.1. Force capacity not less than +/- 340 kN
- 2.2.9.2. Provided with adjustable bearing clearance to minimize backlash
- 2.2.9.3. Swivel angle not less than: - 75 degrees, + 90 degrees
- 2.2.9.4. Title angle not less than: +/- 14 degrees

**2.2.10. Swivel Head Assembly: 1 No.**

- 2.2.10.1. Force capacity not less than +/- 340 kN
- 2.2.10.2. Provided with adjustable bearing clearance to minimize backlash
- 2.2.10.3. Swivel angle not less than: - 75 degrees, + 90 degrees
- 2.2.10.4. Title angle not less than: +/- 14 degrees

### **3. ELECTRONIC CONTROL SYSTEM**

**3.1. Biaxial Seismic Controller: 1 No.**

Controller hardware for one actuator/servo-valve assembly; Digital controller should manage command generation, data acquisition, signal conditioning, event detection, and other servo related tasks; Advanced Digital Universal Signal Conditioning should provide 16-bit resolution for AC and DC transducers, with conditioners utilizing state-of-the-art Digital Signal Processors for low noise and high accuracy.

**3.1.1. Controller Chassis: 1 No.**

Controller hardware for one actuator/servo-valve assembly; Digital controller should manage command generation, data acquisition, signal conditioning, event detection, and other servo related tasks; Advanced Digital Universal Signal Conditioning should provide 16-bit resolution for AC and DC transducers, with conditioners utilizing state-of-the-art Digital Signal Processors for low noise and high accuracy. The controller should be expandable up to 4-station 8-channel. It shall provide the auto zero, bumpless start, hydraulic on mode-switching, and ability to save and restore PID settings. It shall provide programmable libraries for specifically designed for real time control of system.

**3.1.2. I/O Carrier: 2 Nos.**

The I/O carrier board should hold the conditioners, valve drivers, A/D's and D/A's used in the Biaxial Seismic Simulation Controller.

**3.1.3. Real-Time Control Processor: 1 No.**

Should be an upgraded Processor. Direct Digital Control update rate should be higher than 6kHz.

**3.1.4. HPS Interface Board: 1 No.**

To provide interface to HPS (hydraulic power supply)

**3.1.5. Single-Slot Dual HSM Interface Board: 1 No.**

To provide interface to two on/off or off/low/high HSMs

**3.1.6. Valve Driver/Digital Universal Conditioner card: 2 Nos.**

Should either support a 2-stage servo-valve and condition a transducer or support a 3-stage servo-valve. Should provide digitally-controlled fault protection, and 16-bit resolution on valve control.



**3.1.7. DUC (Digital Universal Conditioner) card: 4 Nos.**

Should condition two transducers with following features:

- 3.1.7.1. Support AC and DC transducers
- 3.1.7.2. Normalized with reference for calibrations portability
- 3.1.7.3. Low noise, low drift, high accuracy signal conditioning
- 3.1.7.4. Software control of range, transducer zero, excitation voltage, excitation frequency, and filter characteristics
- 3.1.7.5. Should designed for full range calibrations
- 3.1.7.6. Shut calibration for 100% range
- 3.1.7.7. Should support strain gage bridge completion
- 3.1.7.8. Excitation loss detection
- 3.1.7.9. Software-controlled limit detection

**3.1.8. 8-Input A/D package: 1 No.**

To provide filtered input for 8 analog signals

**3.1.9. 8-Output D/A package: 1 No.**

To provide output for 8 channels analog signals

**3.1.10. UPS 2500 VA for FT60: 1 No.**

**3.1.11. Software**

- 3.1.11.1. Station Builder Softwareinterface for reconfiguring the controller
- 3.1.11.2. Station Manager Softwareinterface to the test station
- 3.1.11.3. Station Desktop Organizer Software to facilitate operation of multiple test stations from one PC by allowing the user to switch the monitor from one station to another.
- 3.1.11.4. Software application that allows the user to define, save and execute simple test procedures
- 3.1.11.5. Software application that ensures that desired levels are achieved on initial pass without over-programming. Facilitates optimizing performance to reproduce wave shape or to maximize test speed.
- 3.1.11.6. Software application that corrects for peaks and mean levels in cyclic wave forms as compensation tool.
- 3.1.11.7. Software application that is useful for programming and control on a channel whose sensor feedback is unsuitable for maintaining closed-loop control.
- 3.1.11.8. Software application that provides overload protection, to make test specimen installation easier.

**3.1.12. Relevant Documentation**

Include relevant product documentation in electronic form.

**3.2. System Cables: 1 No.**

- 3.2.1. Two Delta P Stability cable
- 3.2.2. Ground cable
- 3.2.3. HSM cable, 24V, Hi/Low
- 3.2.4. Two LVDT cables

- 3.2.5. Two servo-valve cables
- 3.2.6. Two servo-valve LVDT cables
- 3.2.7. Four accelerometer cables
- 3.2.8. All cables should be minimum 15 meters long

### **3.3. Personal Computer Package: 1 No.**

- 3.3.1. High performance PC with latest specification
- 3.3.2. 10/100/1000 Ethernet controller
- 3.3.3. Windows XP Professional SP3
- 3.3.4. 22-inch LCD display

### **3.4. Seismic Test Software for Controllers**

Software to perform basic iterations to achieve waveform fidelity of the desired earthquake time history with the following components:

- 3.4.1. Supplier shall provide an accurate feed-forward system model that includes the table, actuators, servo-valve, accumulation, hydraulic pressure, and a specimen. The feed-forward model shall allow for operator interaction and setting of parameters and be able to run as an offline system simulation that can be used for predicting closed-loop control fidelity, test rehearsal, offline tuning, and operator training. Example of the feed-forward model and results from previously installed systems shall be provided with the proposal.
- 3.4.2. Supplier shall provide an accurate inverse system model that includes the table, actuators, servo-valve, accumulation, hydraulic pressure, and a specimen. The inverse model shall allow for operator interaction and setting of parameters and be able to run as an offline system simulation that can be used to predict the physical demands of the system and its ability to meet a desired test. The inverse model shall have the capability to determine the amount of performance required for a test in terms of displacement, velocity, acceleration, oil flow, oil volume, and oil pressure. Examples of the inverse model and results from previously installed systems shall be provided with the proposal.
- 3.4.3. Software for project organization and test data management, with possibility of:
  - 3.4.3.1. Creating new and managing existing projects
  - 3.4.3.2. Integrated launch-pad for individual applications
  - 3.4.3.3. Standalone plotters included to display time history and spectral matrix data
  - 3.4.3.4. Managing project level templates and user configurations
- 3.4.4. Software to access program functionality from network computers
  - 3.4.4.1. Allowing users to setup license server and clients
  - 3.4.4.2. To share program access among several test machines

- 3.4.5. Software for test system configuration
  - 3.4.5.1. Allowing selection of controller to be used with the project
  - 3.4.5.2. Defining drive and response channel configuration
  - 3.4.5.3. Setup channel limits and even-actions
- 3.4.6. Software for identifying the system model
  - 3.4.6.1. Creating shaped white noise drive files
  - 3.4.6.2. Sequential Excitation
  - 3.4.6.3. Calculating both square system models (frequency response functions)
  - 3.4.6.4. Auto-view drive file statistics before playing out to the test rigs
  - 3.4.6.5. Automatic calculation and display of system mode
- 3.4.7. Software to reproduce transducer responses
  - 3.4.7.1. Automatically generate system inverse models based on user frequency control band requirements
  - 3.4.7.2. Automatically remove mean or offsets from achieved responses
  - 3.4.7.3. Automatically displayed convergence evaluation criteria (time history overlays, ASD overlays, statistics, convergence plot)
  - 3.4.7.4. Auto-iterate until RMS of error time history increases
  - 3.4.7.5. Iterate continuously a user specified number of times
  - 3.4.7.6. Stop drive file compensation at problem frequencies
  - 3.4.7.7. Automatically warn of iterations start diverging
- 3.4.8. General purpose tools that can be used for data editing and analysis of time histories and matrix files (e.g. ASCII conversion; channel extract; cut; header modification; import; sequential excitation; spectrums; statistics)
- 3.4.9. Time History with Data Acquisition
 

Software tool supporting playout of time history files and acquisition of time history files on controllers with RPC samples rates up to 1024 pps.

## **4. HYDRAULIC DISTRIBUTION SYSTEM**

### **4.1. Hydraulic Service Manifold, 950 lpm: 1 No.**

- 4.1.1. Maximum total flow capacity of 950 lpm
- 4.1.2. With On/Off, Hi/Low control available
- 4.1.3. 3,000 psi operation
- 4.1.4. 1 station
- 4.1.5. 18.9 L Pressure and 7.6 L Return accumulators
- 4.1.6. 25 micron filtration
- 4.1.7. 24V control voltage
- 4.1.8. Pilot pressure

**4.2. 7.6 m Hose set - 32 pressure, return, -8 drain: 1 No.**

- 4.2.1. Connection End 1: Hydraulic Power Unit
- 4.2.2. Connection End 2: Hydraulic Service Manifold

**4.3. 4.5 m Hose set, 32 pressure, return, -8 drain: 1 No.**

- 4.3.1. Connection End 1: Hydraulic Service Manifold
- 4.3.2. Connection End 2: Actuator/Servo Valve Manifold

**4.4. Hydraulic Distribution Manifold Assembly Structural Test Lab: 1 No.**

**5. INSTALLATION, COMMISSIONING AND TRAINING**

**5.1. Design Review**

Supplier should conduct a design review meeting to review facilities, system functionality and customer responsibilities to ensure coordinated execution of the project.

**5.2. System Installation**

The shake table assembly should be completely assembled and checked out prior to shipping.

5.2.1. Installation - Grouting

Supplier should provide grout material and perform the grouting of the base plate and actuator mounting fixtures. After the grout has cured for one month, technicians should complete the system installation and connect the hydraulic hoses and control cables to the HPU, HSM and controller.

**5.3. System Commissioning**

A function demonstration of the performance of the table should be conducted with a bare table. Tests using a customer-supplied specimen will be conducted.

**5.4. System Training**

After installation, field service technicians have to train the customer in the safe use of the equipment and also the operation of hydraulic system and all features of the control system including software.

A handwritten signature in black ink, appearing to be 'R. M. King', with a long horizontal line extending to the right from the end of the signature.