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TITLE:

Horizontal stabilization of high-rise timber buildings with screwed CLT panels

Horisontal stabilisering av høye trebygg med skrudde CLT skiver

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SUMMARY:
This thesis investigates the potential effect cross laminated timber (CLT) can have when used as a stabilizing component in a framed structure. The study aims to investigate how well exterior fastened CLT panels, fastened with screws to columns, will reduce and dampen the effects of external loading. Due to timber's low density, horizontal displacement and vibrations become critical to investigate, at a time where it's a high demand for high-rises. As part of the WoodSol project, the thesis will be built around moment resisting frames and composite wooden slabs. With screwed CLT panels it is desired to fulfil one of the WoodSol objectives of rapid erection and buildability on site, in addition to offer a vast variety of configurations.

Pre-analysis of the main components together with numerical simulations were conducted prior to experimental testing. A symmetric 3 layered 100 mm thick CLT panel was decided to be used in the experiment. As Eurocode 5 comes shorthanded in recommendation and guidelines of axial- stiffness of fasteners, this thesis investigates how this could be determined and implemented into the overall stiffness of the connector.

Numerical simulations were carried out in both Abaqus and SAP2000, where in-depth analysis of the CLT were simulated in Abaqus, while global stabilization- and dynamic behavior were analyzed in SAP2000. A full-scale model was developed in both programs and detailed information about modelling techniques are presented in the thesis. Based on the preparatory work on fasteners, a screw with dimensions of 11x400 mm was chosen to be installed with an inclination of 30 degrees.

Experimental testing was undergone on a 1:1 mock-up based on the findings of previous WoodSol participants. The CLT panel was fastened to the moment resisting frames and the whole structure was loaded in the "out-of-plane" direction of the frame. In total, 9 configurations of screw layouts were tested during the experiment. Varying between 20-90 screws installed in three columns, each configuration yielded valuable and promising results concerning both horizontal displacement and damping of the system. With a registered reduction of 91,3 % in displacement and an increase of 0,8 % in equivalent viscous damping, the CLT panel showed how effective it can be as a bracing solution when installed properly.

RESPONSIBLE TEACHER: Kjell Arne Malo

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Preface

This master thesis is part of the study program Civil and Environmental Engineering. It is written at the Department of Structural Engineering at the Norwegian University of Science and Technology (NTNU), during the spring semester of 2019. This study is part of the research project *Wood frame solutions for free space design in urban buildings (WoodSol).*

Interest in wood material and timber constructions were the foundation to start examine and develop possible ideas for bracing of high rise timber buildings. With help from our supervisors, boundaries were set and the topic for this thesis was established.

We would like to express our gratitude to Kjell Arne Malo and Haris Stamatopoulos for encouraging and thorough supervision throughout the whole semester. We would also like to thank Ph.D. candidates Sveinung Ørjan Nesheim and Aivars Vilguts for taking the time to assist us and share their knowledge to the benefits of this thesis. We hope some of the findings can be used in a favourable way. A special thanks goes to Terje Petersen, who works at the laboratories at the Department of Structural Engineering, for helping us out with key components for the experimental part of this thesis.

Trondheim, June 24, 2019

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Abstract

This thesis investigates the potential effect cross laminated timber (CLT) can have when used as a stabilizing component in a framed structure. The study aims to investigate how well exterior fastened CLT panels, fastened with screws to columns, will reduce and dampen the undesirable effects from external loading. Horizontal displacement and vibrations are the main focuses. The proposed solution from this thesis is primarily intended to be used in the WoodSol project. Built around moment resisting frames and composite wooden slabs, the WoodSol project is aiming for a structural system that is entirely based upon timber- components. CLT panels substantiate the goal of rapid erection and buildability on site and may be used in a vast variety of configurations. Findings from this thesis, can be used as a foundation and lead towards adaptation in many other types of building projects. The thesis can be divided into three parts, preparatory work, experimental work and post-processing of data.

Pre-analysis of the main components together with numerical simulations were conducted prior to experimental testing. Various thicknesses of CLT panels and types of screws were studied individually and as an assembled component. Varying between 50-300 mm in thickness and 3, 5 or 7- layer buildups, a symmetric 3 layered 100 mm thick CLT panel was decided to be used in the experiment. A thorough review of screw types, lengths, diameter, positioning and inclination were undergone. As Eurocode 5 comes shorthanded in recommendation and guidelines of axial- stiffness of fasteners, this thesis investigates how this could be determined and implemented into the overall stiffness of the connector.

Numerical simulations were carried out in both Abaqus and SAP2000. In-depth analysis of the CLT panel's behavior, i.e lamellar interactions and propagation of stresses, were simulated in Abaqus, while global stabilization- and dynamic behavior were analyzed in SAP2000. Various modeling techniques of CLT elements are presented and compared. A full-scale model was developed in both programs and detailed information is presented in the thesis. Based on simulations and an in-depth study of the fasteners, an optimal screw with dimensions of 11x400 mm was chosen to be installed with an inclination of 30 degrees.

Experimental testing was undergone on a 1:1 mock-up based on the findings of previous WoodSol participants. The CLT panel was fastened to the moment resisting frames and the whole structure was loaded in the "out-of-plane" direction of the frame. In total, 9 configurations of screw layouts were tested during the experiment. Varying between 20-90 screws installed in three columns, each configuration yielded valuable and promising results concerning both horizontal displacement and damping of the system. With a registered reduction of 91,3 % in displacement and an increase of 0,8 % in equivalent viscous damping, the CLT panel showed how effective it can be as a bracing solution when installed properly. The solution showed few practical implications as the assembly process went smooth and required only simple hand tools.

Sammendrag

Denne oppgaven har som mål å undersøke den mulige effekten krysslaminert limtre (CLT) kan ha når det er brukt som en stabiliserende komponent i en rammekonstruksjon. Oppgaven har som mål å finne ut av hvor godt skrudde CLT skiver, festet til utsiden av søyler, vil redusere og dempe uønskede ringvirkninger som følge av ytre påkjenninger. Horisontal forskyvning og vibrasjoner er hovedfokuset i oppgaven. Den foreslåtte løsningen i denne oppgaven er primært tiltenkt og brukes i WoodSol- prosjektet. Med grunnlag i momentstive rammer og komposittdekker ønsker WoodSol- prosjektet å fremlegge et komplett byggesystem, hvor alle komponenter utelukkende er laget av trematerialer. Det er ønskelig at en løsning med krysslaminerte skiver også skal imøtekomme et av hovedmålene til WoodSol, hvor alle komponenter skal bidra til rask og effektiv oppføring av systemet på byggeplassen. Hovedfunnene fra denne oppgaven kan brukes som et grunnlag for videre utvikling, samt være overførbart og brukes i mange andre byggeprosjekter. Oppgaven kan i hovedsak deles inn i tre deler; foranalyse av komponenter, utførelse av eksperiment og analysering av forsøksdata.

En foranalyse av hovedkomponentene sammen med numeriske simulering ble gjennomført før eksperimentelle tester ble utført. Ulike tykkelser på de krysslaminerte skivene samt valg av skruetype ble studert enkeltvis og som en samlet komponent. Ved å variere mellom 50 -300 mm skivetykkelse gjennom ulike 3, 5 og 7- lags oppbygninger, ble det til slutt valgt en symmetrisk 3- lags skive med 100 mm tykkelse. En grundig analyse av skruetype, lengde, diameter, plassering og skråstilling av skruen ble gjennomført. Siden Eurokode 5 er mangelfull på anbefalinger og retningslinjer gitt for aksialstivheten til en forbinder, undersøker denne oppgaven hvordan man kan fastsette stivheten og implementere den som en del av totalstivheten.

Numeriske simuleringer ble gjennomført i Abaqus og SAP2000. Grundige undersøkelser på detaljnivå, som lagsinteraksjoner og spenningsutvikling innad i lamellene, ble gjennomført i Abaqus mens stabilitet- og dynamiske analyser ble gjennomført i SAP2000. Ulike modelleringsteknikker for krysslaminerte skiver er presentert og sammenlignet. En fullskalamodell av forsøksriggen er modellert i begge programmer og presentert med en grundig gjennomgang. Basert på forstudiet av skruer sammen med numeriske simuleringer ble det valgt å bruke en 11x400 mm skrue montert med 30 graders vinkel.

For å verifisere antagelser gjort i førstudiet, ble det utført forsøk i en fullskala rammekonstruksjon. Alle komponentene brukt i forsøket er utarbeidet av personer tilknyttet WoodSol-prosjektet. En krysslaminert skive ble festet på utsiden av søylene i den eksisterende konstruksjonen. Rammen ble påtvunget en forskyvning i retning ut av planet som følge av den påførte kraften. I alt ble det testet 9 ulike skruekonfigurasjoner. Ved å montere mellom 20-90 skruer i hver av de tre søyler, viste hver konfigurasjon seg å gi gunstige resultater med tanke på horisontal forskyvning og dempningen av konstruksjonen. Med en reduksjon på 91,3 % i horisontal forskyvningen og en økning på 0,8 % i ekvivalent viskøs dempning, viste skiven hvor god og effektiv den kan være når den er montert skikkelig. Løsningen viste seg å være svært montasjevennlig, hvor kun enkelt verktøy ble brukt, noe som svarer godt til et av prosjektmålene til WoodSol.

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Chapter 1

Introduction

1.1 Motivation

Wood as a construction material is considered cleaner and more environmental friendly than its main competitors. Through the photosynthesis in wood, CO_2 is consumed to produce sugar and oxygen which are vital constituents for the growth. A large part of the carbon absorbed is stored as biomass and will be retained in the wood until decay or destruction. These abilities make wood favorable, given the fact that the construction industry is responsible for close to 40% of the total energy-related CO_2 emissions[7].

Although timber products are mostly associated with and used in residential houses and smaller buildings, there are now numerous examples where it is adapted to larger projects such as hotels and student homes. The desire to further develop timber products and bypass many of the traditional building solutions based on concrete and steel is strong, and there is great optimism around making the construction industry more sustainable.

In later years, from the mid 90s, the use of cross laminated timber (CLT) has skyrocketed in terms of production and applicability. A lot of uncertainties, regarding behavior and performance, are now minimized due to extensive research by key contributors, such as Blaßet.al [8] and Follesa et. al [9]. Although there are many advantages that promote the use of timber products in high rise buildings, there are still problems yet to be solved. Higher buildings are, as an example, dependent on the mass from its components to withstand and dampen the undesirable effects from external forces, such as wind. A light material like wood, is therefore more troublesome to use as the main material in a building, due to the likelihood of higher accelerations and deflections.

From previous theses [10][11], it has been shown that the criteria for the serviceability limit state (SLS) is difficult to fulfill for high-rise timber buildings. SLS requirements for acceleration and horizontal deflection in the uppermost floor are easily compromised and well outside acceptable values. CLT walls and diagonals made of glued laminated timber are both effective components to increase stiffness and dampen accelerations and displacements. An unwanted side effect however, is that an increase in the natural frequency of the building leads to more demanding requirements to fulfill. The requirements aside, CLT walls and diagonals are currently the most advantageous timber products used as bracing in higher buildings. Combining the two, they are almost independent of floor plans and building layouts due to their high level of adaptability.

1.2 WoodSol and reference project

Following the increased urbanization unfolding in the major cities over the last decades, the consensus in the construction industry has been to build upwards. This has led to an increasing number of high rises worldwide. Up until today, a vast majority of the residential and office buildings are built using traditional materials such as reinforced concrete and steel. A survey made out by Statsbygg[12], disclosed that developers were unwilling to use timber due to lack of knowledge and industrialized structural solutions.

From reference, it was suggested that government-funded research projects should explore the possibility of building with timber. WoodSol, initiated in 2016, is a research project financed by the Research Council of Norway and the consortium partners. The aim is to develop industrialized structural solutions based on rigid wooden frames for use in urban buildings up to ten stories and with large architectural flexibility [13]. The WoodSol project has established three main objectives to reach the target of a more sustainable construction industry:

1. The extension of the floor span length without increased story height.
2. The horizontal stabilization of the building by moment resisting frames (MRF).
3. The development of prefabricated couplings to allow rapid erection on site.

A large focus is emphasized on rapid and practical erection on site. This means that all new components have to accommodate these requirements in addition to its intended purpose. Based on the extensive research and proposed solutions by WoodSol participants, Løvseth+Partner has developed an apartment building with detailed technical solutions, see Figure 1.1. Moment resisting frames and timber composite slabs are the main components of the structural system and are considered the baseline for further development. In addition to the conceptual building, numerical models of system components and full-sized frames have been developed and analyzed.

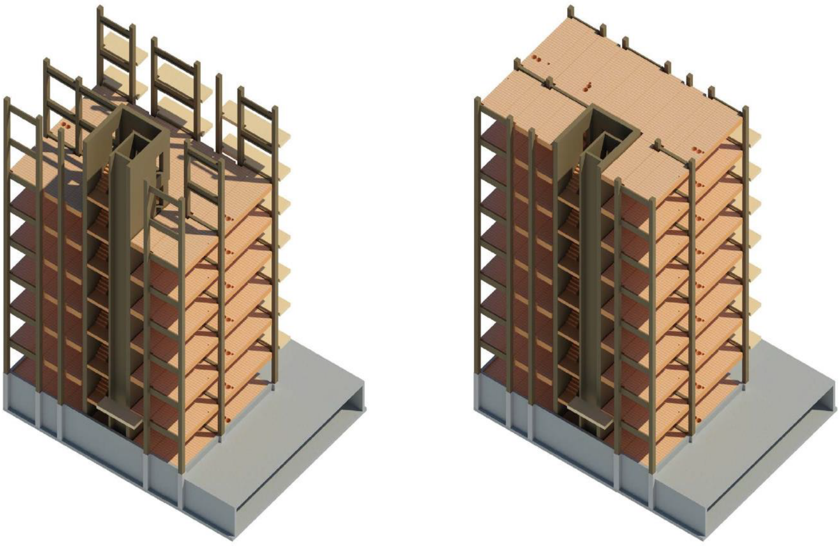


Figure 1.1: Layout of the reference building

1.3 Objectives

The aim of this thesis is to investigate the potential effect of a stabilizing CLT panel, when fastened with screws on the exterior side of a moment resisting frame. The desirable effects are to be categorized into horizontal displacement, damping of the system and development of the natural frequency. An experiment on a 1:1 scale mock-up will be planned and carried out. Furthermore, a numerical model with the goal of describing the mock-up as accurate as possible will be built. The experimental results will be used to verify and calibrate the model.

To substantiate the main goal and contribute in the most favourable way to the WoodSol project, the following objectives are defined and pursued:

- What are the most common methods of modeling CLT, and how do they compare to each other when tested numerically.
- How does variation in thickness - and layup composition of a CLT element effect the behavior of a structural system.
- How can screws with an inclination be modeled in 2D and 3D.
- How does the arrangement of screws impact the overall stiffness.
- What are the main differences between experimental and numerical results.
- How can experimental results be implemented to minimize the uncertainty in a computer model.

1.4 Limitations

- This thesis is limited to only examine the stiffness contribution from a CLT panel to a structural system. No other components or bracing solutions are studied. The horizontal displacement is the only one of interest, thus, vertical displacement, rotation of the CLT panel etc are omitted.
- Moisture-induced factors are not taken into account. Moisture content was not measured prior to testing.
- No acoustic measurements, simulations or evaluations are done.
- Ultimate limit state is not considered in this thesis.

1.5 Readers guide

Chapter 2 - Background - Describes the most essential background knowledge used in this thesis. Basic knowledge in statics, FEM- theory and building systems are assumed known by the reader.

Chapter 3 - Preparatory - Describes the parametric study, undergone for both CLT and screws, prior to experimental testing. This chapter also presents detailed information on every component used in the mock-up and how they are implemented in SAP2000.

Chapter 4 - Experimental work - This chapter contains a complete walkthrough of the setup and tests performed on the mock-up.

Chapter 5 - Results - All results are presented here, both experimental and numerical. The findings are categorized into force-displacement, dynamics and modal results.

Chapter 6 - Evaluation - Both numerical and experimental results are evaluated individually and compared to each other. Key findings are presented. A small evaluation of the modeling, experimental testing and post-processing of data is also conducted, discussing potential sources of error.

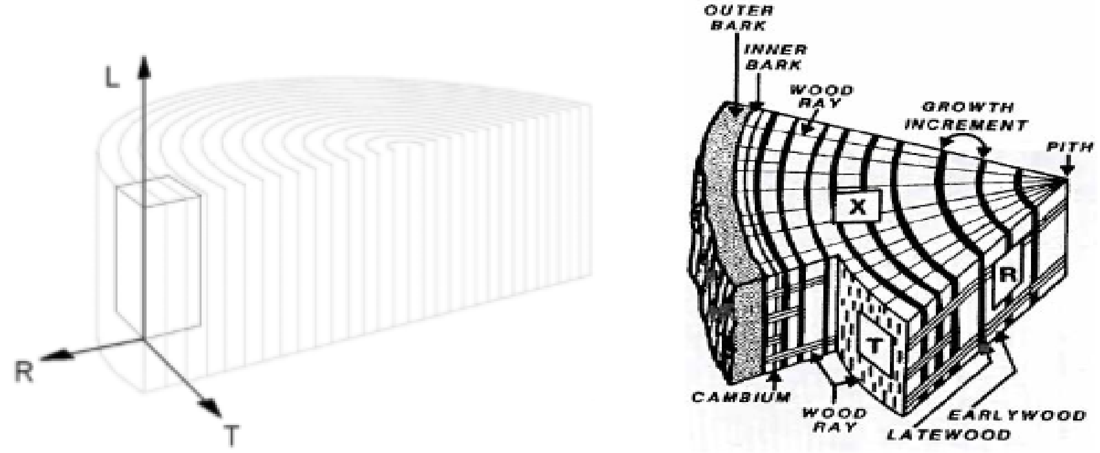
Chapter 7 - Conclusion and further work - Presents a final conclusion and gives suggestions for further work.

Chapter 2

Background

2.1 Wood as a construction material

Wood is an anisotropic material, and with some simplifications a specimen of wood can be divided into three material orientations, a longitudinal, radial and tangential direction, see Figure 2.1a. Simplified to an orthotropic material, the longitudinal stiffness throughout the specimen is up to fifteen and thirty times higher than the radial and tangential stiffness, respectively [5].



(a) Orthogonal material axis system [5]

(b) The appearance of the macrostructure; X - cross-sectional or transverse surface, R - radial surface, T - tangential surface [14]

Figure 2.1: Axis system and macrostructure of wood

The characteristic macrostructure of timber is formed by concentric annual rings, which are a consequence of the varying growth conditions throughout a year. Annual rings are made up of a layer of earlywood, which develops at high speed during the first phase of the growth season, and latewood which develops at a moderate rate towards the end of the growth season [15]. The cross-section of earlywood is large, but the cell walls are thin, while latewood has a smaller cross-section, but sturdier and thicker cell walls. The center, of the annual rings, is denominated as pith [16], see Figure 2.1b.

The sawmilling determines how the annual rings are orientated on the sawn timber, as the location of the pith will change. Therefore for different cut patterns, the sawn timber characteristics will not be the same as seen in Figure 2.2, and will have a deviation in the mechanical response to the loading.

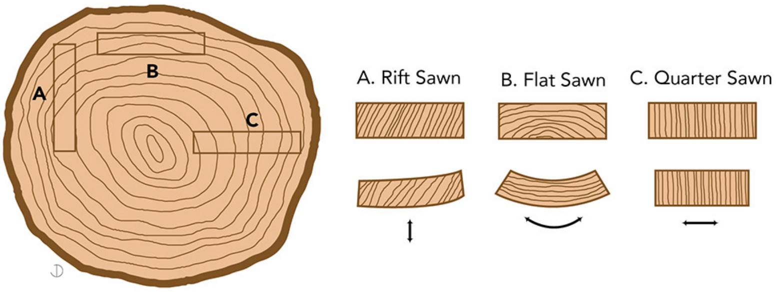


Figure 2.2: Example of how sawing patterns affects the grain orientations

Wood has high specific stiffness, meaning a high stiffness compared to the weight. For elements where most of the load is from the self-weight, e.g. slabs, the use of wood will result in reduced loads. This will correspondingly lead to a lighter construction, which is beneficial in areas where the foundation is limited, e.g. urban environments. It might also be disadvantageous with respect to dynamic loads and vibrations [17].

2.2 Bracing system

With its low density, timber high rises are prone to unfavorable horizontal displacement. Through WoodSol moment resisting frames have been developed and proved to greatly impact the stiffness of a system. Stiffness is related to stability, which governs the performance of the building. Three conventional bracing solutions, introduced in a building to enhance stability are depicted in Figure 2.3.

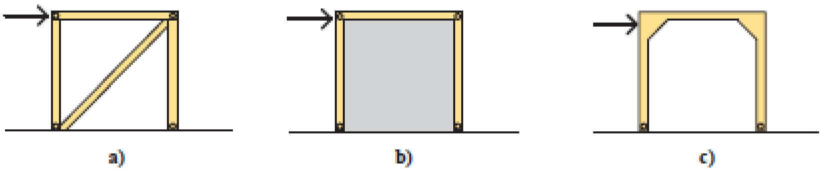


Figure 2.3: Conventional bracing solutions[1]

For timber high rises, there are many examples where glulam diagonals are used to fulfill the necessary requirements related to dynamic loading, e.g. wind loads. Mjøstårnet in Brummundal, Norway is one example where diagonals are used to achieve stability of the 18 stories high timber building. Even though glulam diagonals are widely used in the construction industry, it is in many cases not sufficient as the only bracing solution and needs to be complemented. Examples of this are found in the aforementioned Mjøstårnet and Lifecycle Tower-ONE, where it is introduced composite concrete-timber floors and concrete shafts, respectively. Hence, new solutions are investigated involving moment resisting frames and shear walls.

Load path

Universal for all structures is that they are exposed to both vertical - and horizontal loads, where the scope of the structural engineer is to establish load paths that carry the external load from the point of action, down to its foundation. The horizontal- and vertical load path is referred to as a lateral- and gravity load path, respectively [18]. As the objective of this thesis is to find bracing solutions that minimize the horizontal deflections on the structure, gravity load (i.e. dead load, live load and snow load) will not be discussed any further. For the reference building (i.e Figure 1.1), with wind-induced loading, a situation close to what is depicted in Figure 2.4 would be a reasonable load path assumption. The accumulated point load at each joint needs to be transferred down through the structural system. In order to resist the load, bracing components are necessary. By applying additional stiffness to the system, the load path is shifted. The principle is based on that the load is transferred through the components that possess the highest stiffness. Consequently, a shear wall made out of CLT, with a perfect rigid fastener connection, would almost completely diminish the other structural components. However, for timber structures it cannot be assumed that the connection is rigid due to timber's inherent characteristics.

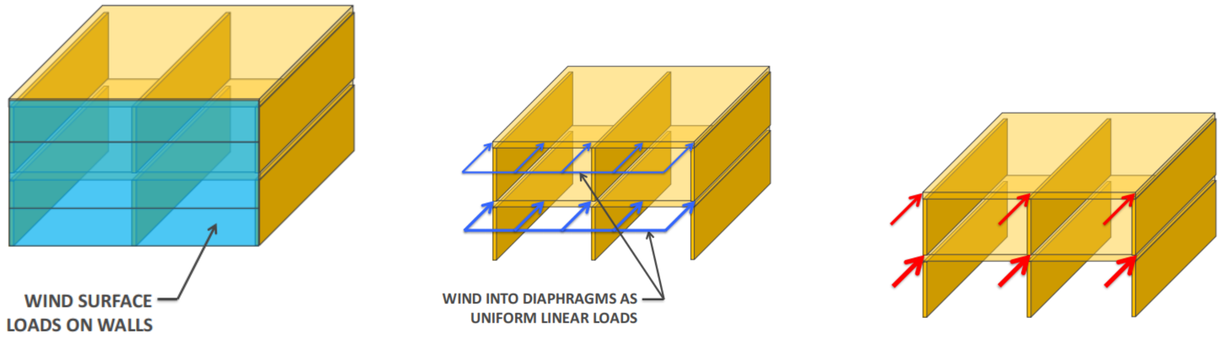


Figure 2.4: Wind induced loading, with load path

The stiffness of the connection will, therefore, have a substantial influence on the distribution of load. By increasing the connection stiffness, it allows for more of the shear wall to be utilized, hence higher load transmission.

2.3 Cross Laminated Timber

This section is mainly based on the book "Treteknisk håndbok- bygge med massivtreelementer" [19][20] unless otherwise stated.

Cross laminated timber is a laminated solid wood product for structural load-bearing use. CLT is made up of layers of wood laminates, where each layer is oriented perpendicular to the adjacent layer, i.e 90°. Strong structural adhesive is commonly used to bond the layers together [21].

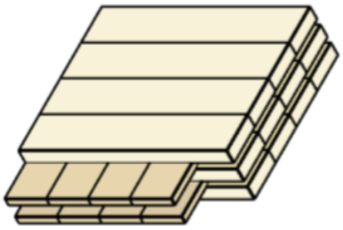


Figure 2.5: CLT layup

The layers can have different thicknesses and qualities. The outer layers usually have higher quality, as it contributes more to the overall flexural-stiffness of the element. By being a composite material, CLT is less prone to get its capacity compromised due to flaws in one layer is unlikely to be present at the same point in the adjacent lamellae.

CLT elements are usually prefabricated with fitting groves at the narrow side or preparations in terms of cut-outs for windows or ducts, leading to a decrease in installation time. Standardized element sizes are mostly limited by transportation, and can be up to 16 meters in length and 3 meters in width. Normally CLT panels are three, five or seven layers, and the total thickness varies between 60 and 300 mm.

When exposed to moisture, CLT as all wooden materials, experience swelling and shrinkage. However, due to CLT being made up of layers with angles to the adjacent layer, some layers will experience axial stresses due to adjacent layers inducing tangential strains. The axial stiffness, being up to fifteen and thirty times stiffer than the radial and tangential stiffness, will prohibit larger deformations. CLT is suitable as wall and floor elements, as they are able to carry load in two directions. This capability means that CLT can be subjected to loads perpendicular to plane (floors) and parallel to plane (shear walls). Dependent on the plane the element is loaded, the stiffness and strength will vary.

Wood has in general low resistance to rolling shear. The rolling shear resistance is said to be around ten percent of the shear modulus of the wooden material. Local deformation of the CLT is therefore largely dependent on the perpendicular layers, as illustrated by Figure 2.6. To reduce the shear deformation, the ratio between the width and thickness of each lamella should not be too low, and a recommended value is 4.

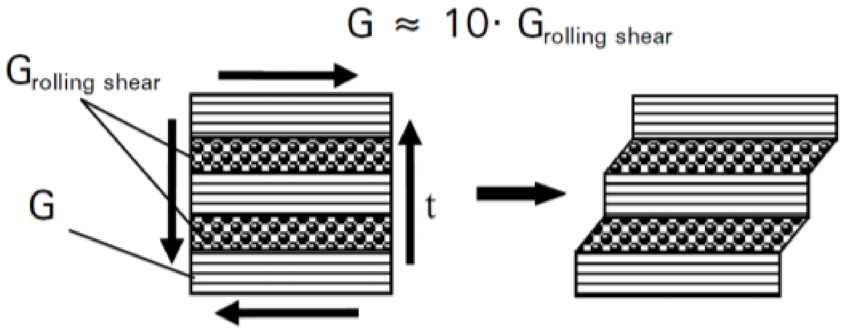


Figure 2.6: Rolling shear deformation in CLT[2]

2.4 Dynamics of structures

This section is based on the book "Dynamics of Structures Theory and applications to earthquake engineering" by Prof Dr. Anil K. Chopra.

Each structural member in a building contributes to the inertial (mass), elastic (stiffness or flexibility), and energy dissipation (damping) properties of the structure. In an idealized system each of these properties, for all members, are concentrated into three separate components: mass, stiffness and damping.

For a linear elastic system, the relationship between the lateral force f_S and resulting deformation u is linear, that is,

$$f_S = k \cdot u \tag{2.1}$$

Where k is the lateral stiffness of the system. This linear relationship implies that f_S is a single-valued function, i.e. the loading and unloading curves are identical. For an inelastic system, the initial loading curve is nonlinear at the larger amplitudes of deformation, and the unloading and reloading curves differ from the initial loading branch. Figure 2.7 shows this relationship determined by experiments for a structural steel component undergoing cyclic deformations during earthquakes. This implies that the force-deformation relation is path dependent, i.e. it depends if the deformation is increasing or decreasing. Thus the resisting force is an implicit function of deformation:

$$f_S = f_S(u) \tag{2.2}$$

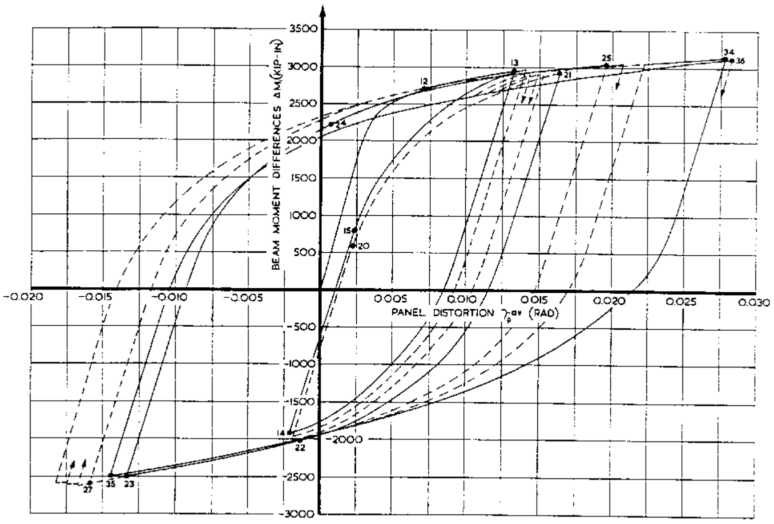


Figure 2.7: Force - deformation relation for a structural steel component.[3]

The force-deformation relation for the idealized structure can be determined in two ways. Either by the use of a nonlinear static structural analysis, or by defining the inelastic force-deformation relation as an idealized version of experimental data.

The process by which vibrations steadily diminish in amplitude is called damping. In damping the kinetic energy and strain energy of the vibrating system are dissipated by various damping mechanism, and often more than one mechanism may be present at the same time. in simple systems, such as experimental laboratory models, most of the energy dissipation presumably arises from the thermal effect of repeated elastic straining of the material and from internal friction when a solid is deformed. In actual structures, many other mechanisms also contribute to the energy dissipation, e.g. friction at steel connections, opening and closing of micro-cracks, friction between the structure and nonstructural elements, etc. This makes it incredibly hard to identify or describe mathematically each of these energy-dissipating mechanisms. As a result, the damping in actual structures is usually represented in a highly idealized manner and is called the equivalent viscous damping.

At larger deformation, additional energy is dissipated due to the inelastic behavior of the structure. Under cyclic forces or deformation, this behavior implies a formation of a force-deformation hysteresis loop as illustrated by Figure 2.8. The damping energy dissipated during one cycle is given by the area within the hysteresis loop.

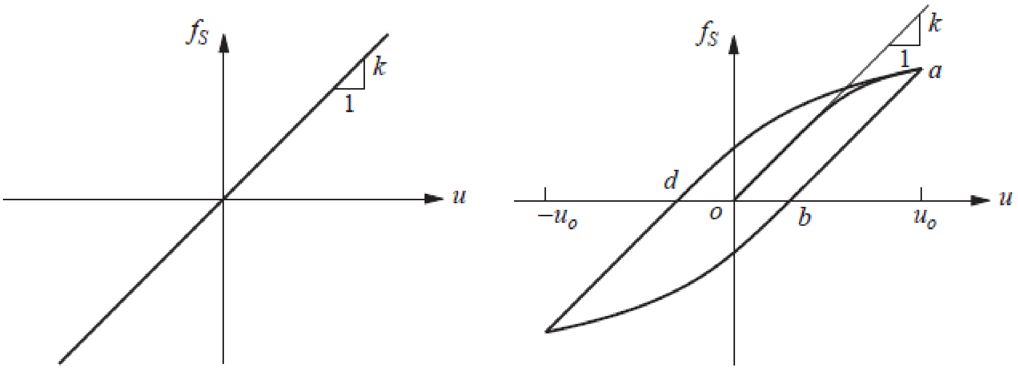


Figure 2.8: Force-displacement relationship for an elastic and inelastic system

A structure is said to be undergoing free vibration when it is disturbed from its static equilibrium position and then allowed to vibrate without any external dynamic excitation. The rate at which the motion decays in free vibration is controlled by the damping ratio. The differential equation governing the free vibration of a single degree of freedom system with damping is given by Equation 2.3.

$$m \cdot \ddot{u} + c \cdot \dot{u} + k \cdot u = 0 \tag{2.3}$$

Dividing by m gives

$$\ddot{u} + 2 \cdot \zeta \cdot \omega_n \cdot \dot{u} + \omega_n^2 \cdot u = 0 \tag{2.4}$$

where the natural frequency $\omega_n = \sqrt{\frac{k}{m}}$ and $\zeta = \frac{c}{2 \cdot m \cdot \omega_n}$. The damping constant c is a measure of the energy dissipated in a cycle of free vibration or in a cycle of forced harmonic vibration, while ζ is the damping ratio which is a property of the system that also depends on its mass and stiffness. Figure 2.9 shows a plot of the motion $u(t)$ due to initial displacement $u(0)$ for three values of ζ. If $c < c_{cr}$ or $\zeta < 1$, the system oscillates about its equilibrium position with a progressively decreasing amplitude. If $c = c_{cr}$ or $\zeta \ = 1$, the system returns to its equilibrium position without oscillating. If $c > c_{cr}$ or $\zeta > 1$, again the system does not oscillated and returns to its equilibrium position, as in the $\zeta = 1$ case, but at a slower rate.

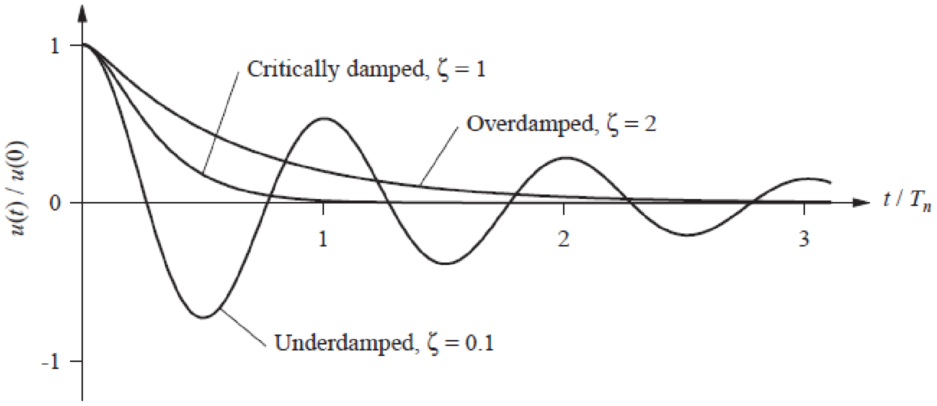


Figure 2.9: Damping ratios in a free vibration system

The damping coefficient c_{cr} is called the critical damping coefficient because it is the smallest value of c that inhibits oscillation completely, and it represents the dividing line between oscillatory and non- oscillatory motion. Structures of interest - buildings, bridges, dams, nuclear power plants, offshore structures, etc. - all fall into the underdamped systems category.

The more important effect of damping is on the rate at which free vibration decays. This is displayed in Figure 2.10, where the free vibration due to initial displacement $u(0)$ is plotted for having the same natural period T_n but differing damping ratios.

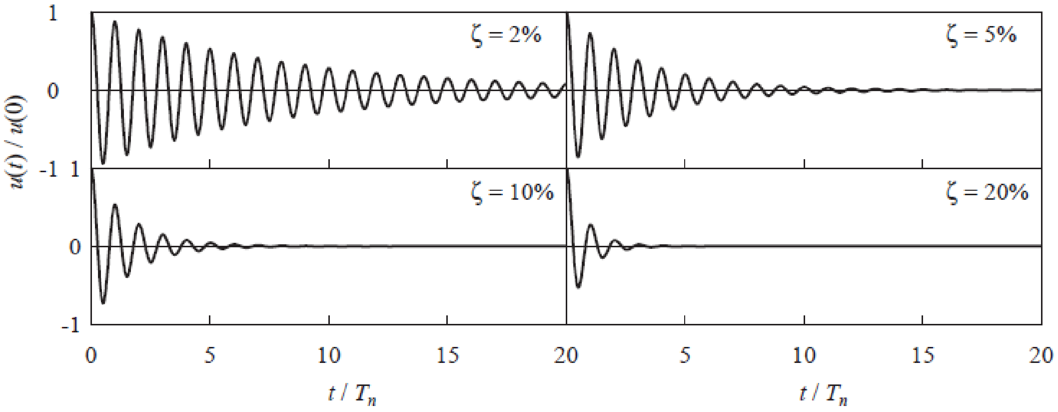


Figure 2.10: Free vibration of systems with four levels of damping

The most common method for defining equivalent viscous damping is to equate the energy dissipated in a vibration cycle of the actual structure and an equivalent viscous system. For an actual structure, the force-displacement relation is obtained from an experiment under cyclic loading with displacement amplitude u_o: such a relation of arbitrary shape is shown in Figure 2.11. The energy dissipated in the actual structure is given by the area E_D enclosed by the hysteresis loop. Equating this to the energy dissipated in viscous damping leads to:

$$4 \cdot \pi \cdot \zeta_{eq} \cdot \frac{\omega}{\omega_n \cdot} \cdot E_{So} = E_D \qquad or \qquad \zeta_{eq} = \frac{1}{4\pi} \cdot \frac{1}{\frac{\omega}{\omega_n}} \cdot \frac{E_D}{E_{So}} \tag{2.5}$$

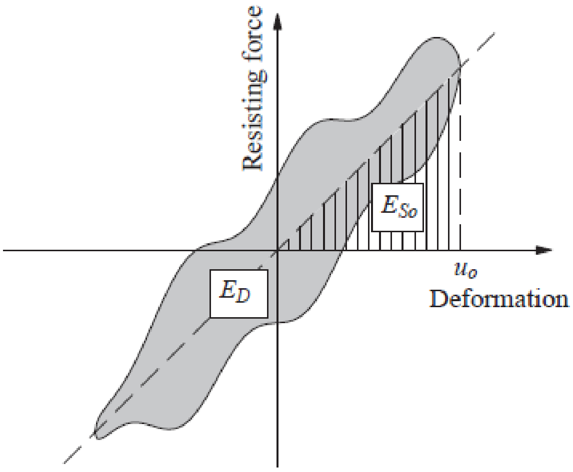


Figure 2.11: Energy dissipated,E$_D$, in a cycle of harmonic vibration

where the strain energy $E_{So} = k \cdot u_o^2/2$, is calculated from the stiffness k determined by experimentation. The experiment leading to the force-deformation curve of Figure 2.11 and hence E_D should be conducted at $\omega = \omega_n$, where the response of the system is most sensitive to damping. Thus Equation 2.5 specializes to

$$\zeta_{eq} = \frac{1}{4\pi} \cdot \frac{E_D}{E_{so}} \tag{2.6}$$

The equivalent viscous damping ratio ζ_{eq} determined from a test at $\omega = \omega_n$ would not be correct at any other exciting frequency, but it would be a satisfactory approximation.

There are three principle actions that dynamic loads can inflict on a structure, which makes them unacceptable for humans to inhabit [22].

1. The functional requirements of the building are not met. There is no danger of mechanical failure, but practical usage of the structure proves difficult. The most common cause being greater acceleration then what is experienced as comfortable.
2. Mechanical damage or collapse as a result of reaching the load threshold.
3. Fatigue of the materials due to load cycles.

In this master thesis, the functional requirements are of interest. Specifically, the vibrations caused by the wind load that affects inhabitants. The complexity of the wind itself and the flow pattern distribution around buildings, makes the response due to wind loading a complicated matter. However, the response can be split into a mean and an oscillating component. The mean part can be treated as a static load corresponding to the mean wind speed, while the oscillating component, the outcome of deviation from the mean wind speed, is dependent on more parameters, e.g geometry of the structure, neighboring terrain and wind profile. This phenomenon, also known as turbulence, emerge as translational and torsional vibrations measured by the acceleration of the top story. Careful consideration of vibrations in high-rise structures needs to be taken into account. The gust factor approach is a simplified method to find the acceleration, and is based on the theory of splitting the wind load [23].

The proposition, offered by NS-EN 1991-1-4 for calculating accelerations, is based on the gust factor approach[24], and has shown to foresee the dynamic response with acceptable accuracy [23]. There are nonetheless certain requirements for using this method, e.g simplified geometry (see Figure 2.12) and period of oscillation.

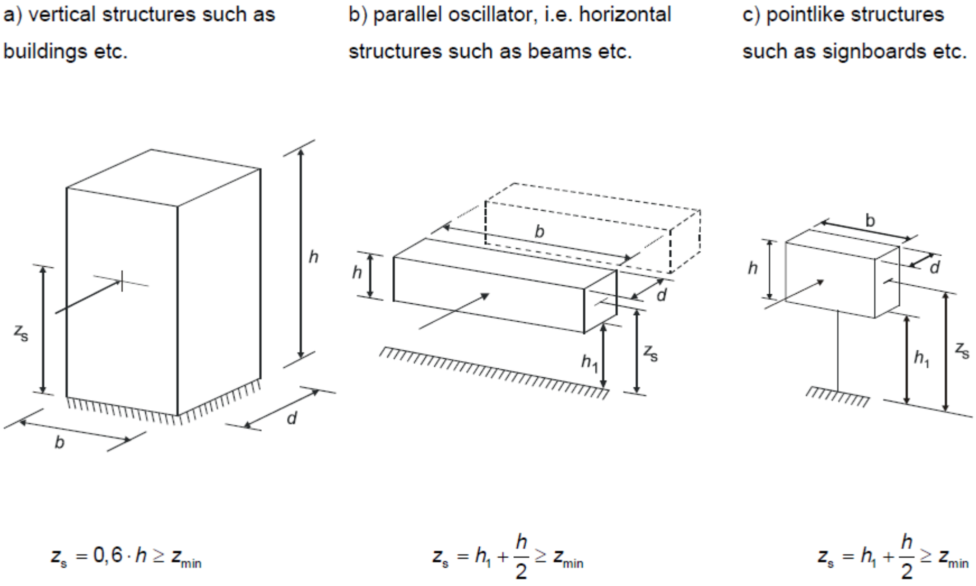


Figure 2.12: Simplified building geometry according to Eurocode 1

2.5 Acceleration criteria

Individuals experience and react differently to vibrations, making it hard to set clear limits on acceptable acceleration in buildings. There is no internationally agreed criteria, but a limit for the perception of horizontal acceleration is 0.02 m/s^2, which only two percent of the population can perceive. 0.05 m/s^2 can be felt by half the population, and 0.098 m/s^2 is a limit at which nausea and motion sickness occurs [25].

ISO 10137 is used as the basis for the design of structures, with respect to the serviceability of buildings and walkways against vibrations [26]. The standard specifies the comfort criteria for varying natural frequencies, see Figure 2.13. The strictest criteria range between 1-2 Hz, in which most high-rise timber buildings are located. The criteria is based on the peak acceleration with a return period of one year.

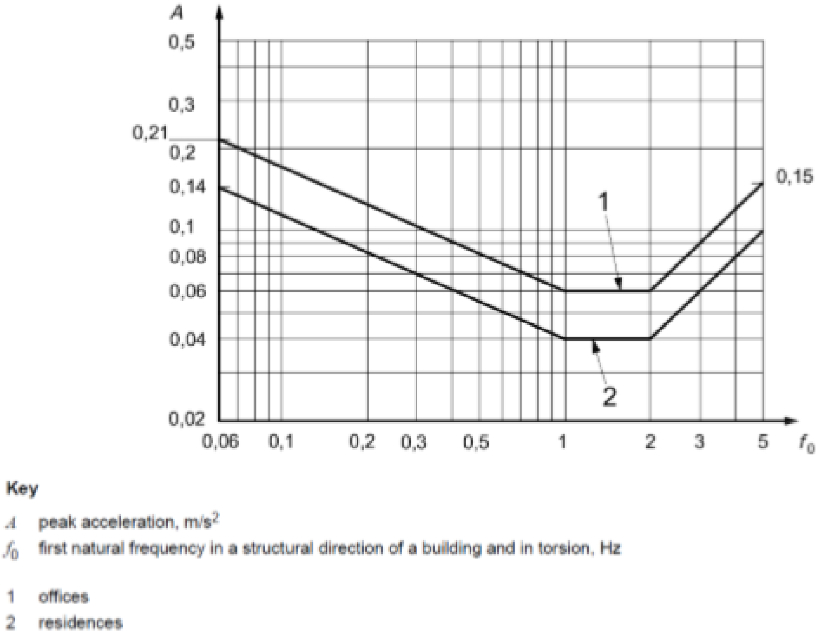


Figure 2.13: The comfort criteria for vibrations according to ISO 10137

2.6 Fastener stiffness

Eurocode 5 [27] has limited information when it comes to calculating the lateral joint slip for various types of fasteners. The formula is independent of the angle between the fastener and the two, or more, compound members. The slip modules for dowels and screws per shear plane, per fastener, is given as [27]:

$$K_{ser} = \rho_m^{1,5} d/23 \tag{2.7}$$

where:

ρ_m is the mean density

d is the outer diameter of the fastener

As for screws with an inclination, the Eurocode comes short to determine their stiffness other than Equation 2.7. The resistance of the stiffener shifts from lateral to pure axial as the angles increase towards the limitations regarding angle to grain given in the code. Theoretical and experimental work has been carried out to predict the capacity of inclined fasteners. Noteworthy contributors are Tomasi et.al.[28] and Girhammar et.al [29]. Both emphasize the importance of fastener angle, embedded length and the contribution from friction acting between the timber elements. The theory and formulas presented by Tomasi et.al are used as the foundation for further calculations in this thesis.

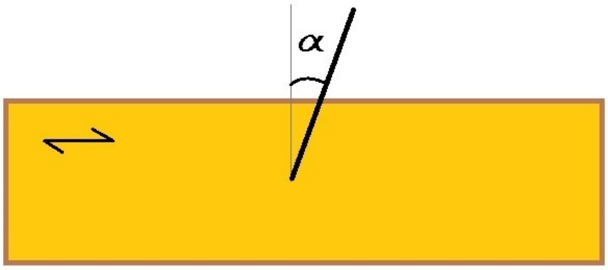


Figure 2.14: Angle of fastener α

The slip modulus for fastener in a shear- tension loading situation which incorporates fastener angles is given by Equation 2.8.

$$K_{ser} = K_{\perp} \cdot \cos\alpha \cdot (\cos\alpha - \mu \cdot \sin\alpha) + K_{\parallel} \cdot \sin\alpha \cdot (\sin\alpha + \mu \cdot \cos\alpha) \tag{2.8}$$

where:

$K_{\perp}$ is the connector stiffness for lateral loading

$K_{\parallel}$ is connector stiffness for withdrawal loading

α is the angle of the fastener, see Figure 2.14

μ is the friction coefficient, often set to 0,25

For fasteners that are subjected to a compression force, the friction coefficient is set to zero, which results in a pure decomposition of the stiffness contributions. $K_{\perp}$ is given in Equation 2.7 and is valid for all dowel and screw types.

The axial stiffness $K_{\parallel}$ is governed by the physical dimensions and the mechanical behavior of the screw. For a single or double shear connection, the axial stiffness is expressed by Equations 2.9-2.10 respectively:

$$K_{\parallel} = K_{ser,ax} \tag{2.9}$$

$$K_{\parallel} = \frac{1}{\frac{1}{K_{ser,ax,1}} + \frac{1}{K_{ser,ax,2}}} \tag{2.10}$$

There are currently no standardized methods to calculate the axial stiffness. Therefore the user should refer to technical approvals provided by the manufacturer of the particular fastener. Some of the expressions provided by manufacturers and experimental testing are presented in Equations 2.11 - 2.14.

Rotho Blaas Self-tapping Screws[30]

$$K_{ser,ax} = 780 \cdot d^{0.2} \cdot l_{ef}^{0.4} \tag{2.11}$$

SFS Self-tapping Screws WT[31]

$$K_{ser,ax} = 25 \cdot l_{ef} \cdot d \tag{2.12}$$

Presented by Tomasi et.al[28]

$$K_{ser,ax} = 30 \cdot l_{ef} \cdot d \tag{2.13}$$

Experimental results from Blaß et.al[32]

$$K_{ser,ax} = 234 \cdot (\rho_m \cdot d)^{0.2} \cdot l_{ef}^{0.4} \tag{2.14}$$

where:

d	is the outer diameter of the fastener
l_{ef}	is length of the threaded embedded part
ρ_m	is the mean density of the timber components

The importance of axial stiffness and the potential contribution to the overall stiffness of the fastener is presented in the Ph.D. thesis of Haris Stamatopoulos [33]. Equations 2.11 - 2.14 clarifies the contribution to the overall stiffness that is neglected by Eurocode 5 [27]. Thus, by use of Equation 2.8, the total stiffness of a fastener can be calculated for any angle within certain limits.

2.7 Concept of a spring system

Basic physics of springs and elementary structural analysis principles, can effectively be used to check numerical analysis calculations, and also assist in the design of structural connections to be used in a structure. Complex structures can easily be represented as an assembly of parallel springs and springs in series. Determining the equivalent stiffness of the entire system can be readily done by considering the Hooke's Equation 2.15, and therefore also the deflection of the system [34].

$$F = k \cdot \delta \tag{2.15}$$

When an assemblage of springs deflects equivalent to each other, i.e equally, when subjected to a force, it is said that the springs are parallel to one another. For springs in parallel, the equivalent stiffness is obtained by adding the individual stiffness of each spring [34], see Equation 2.16.

$$k_{eq} = k_1 + k_2 + ... + k_n \tag{2.16}$$

When an assembly of springs deflects by different amounts, i.e unequally, when subjected to a force, it is said that the springs are in series. For springs in series, the equivalent stiffness is obtained as Equation 2.17 [34].

$$k_{eq} = \frac{1}{\frac{1}{k_1} + \frac{1}{k_2} + ... + \frac{1}{k_n}} = \frac{k_1 \cdot k_2 \cdot .... \cdot k_n}{k_1 + k_2 + ... + k_n} \tag{2.17}$$

No matter how complex a linear elastic structure is, it can in general be modeled as a system of springs in parallel or series with each other, as illustrated by Figure 2.15.

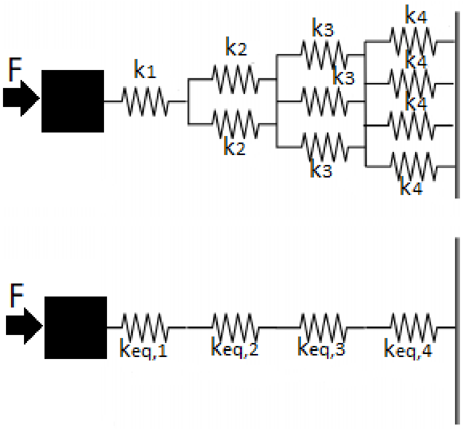


Figure 2.15: Equivalent system of springs

Chapter 3

Preparatory

3.1 modeling of CLT

To model wood accurately, the material orientation and pith position are crucial to account for, in order to give a good representation of how the material behaves. This can be done by defining a local cylindrical coordinate system for each individual board of timber. The local coordinate of the Z-axis (longitudinal direction) defines the position of the pith, while the local R-axis (radial) and T-axis (tangential) implements the material orientation for the cross-sectional plane [16], as Figures 3.1 and Figure 3.2 illustrate.

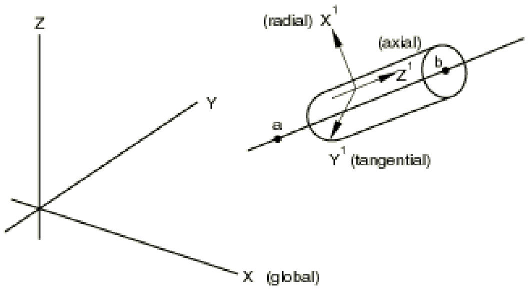


Figure 3.1: Cylindrical coordinate system

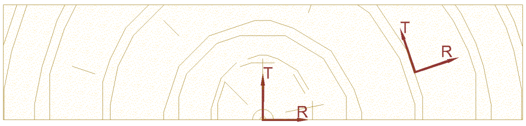


Figure 3.2: Local cylindrical coordinate system

The orthogonality of wood introduces difficulties related to creating a numerical model, hence a lot of resources are devoted, from different research teams worldwide, to find accurate representations [16]. This thesis will present and compare four methods of modeling CLT elements.

3.1.1 3D model of wood with Abaqus CAE developed by the Technical Research Centre of Finland

Abaqus CAE gives the user the freedom to define geometry, boundary conditions, material properties, mesh and loads. By following these guidelines it is possible to create a model of CLT [16]:

1. Create a 3D deformable solid extrusion of the CLT element in its full size.

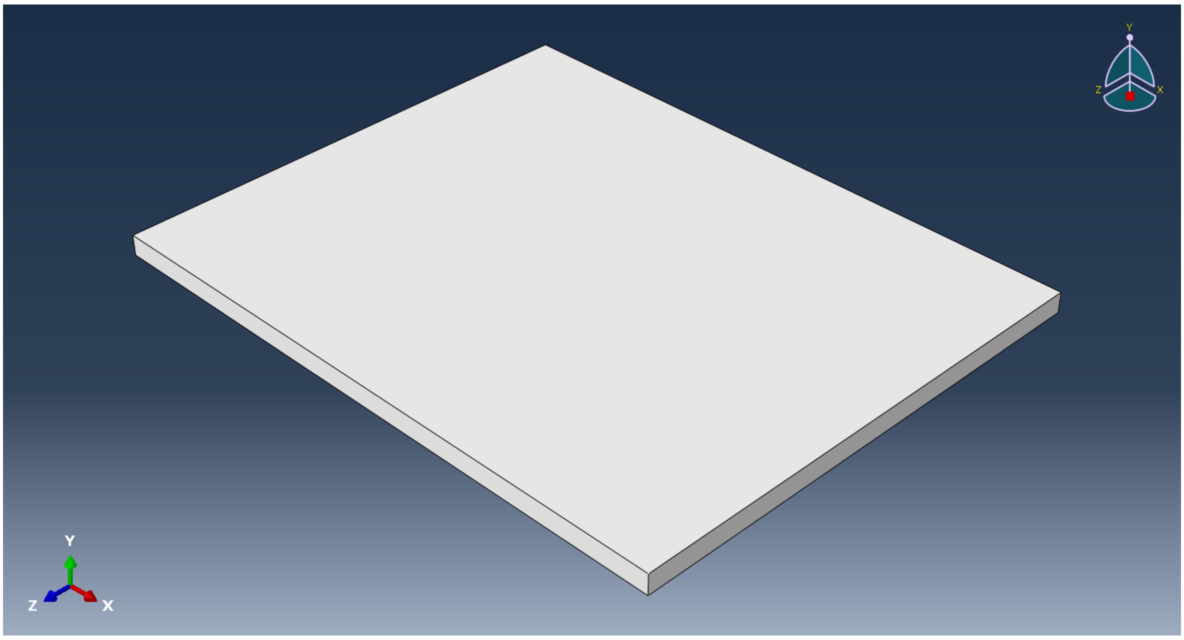


Figure 3.3: 3D deformable solid extrusion of the CLT element

2. Partition the 3D solid into lamellae and boards. This will avoid discontinuities between the layers and boards in the structure.

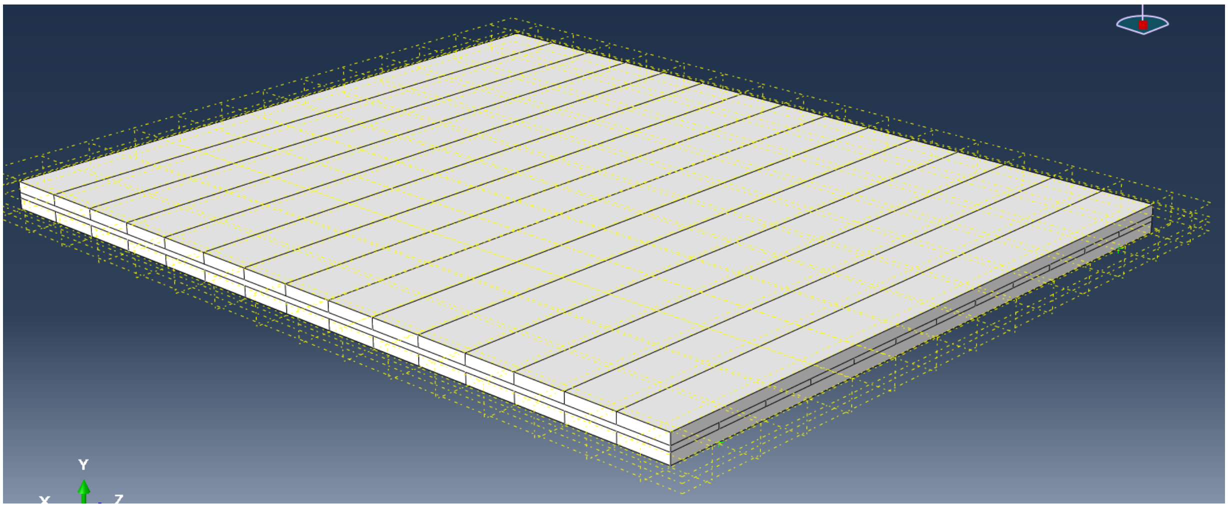


Figure 3.4: CLT element partitioned into lamellae and boards

3. Create a local cylindrical coordinate system for each board of timber. The location of the coordinate systems will be the pith for each piece of wood, and placement should therefore be considered with this in mind. The recommended position is in the middle of the bottom edge for each board. The definition should be in accordance with Figures 3.3-3.4, and should look like Figure 3.5.

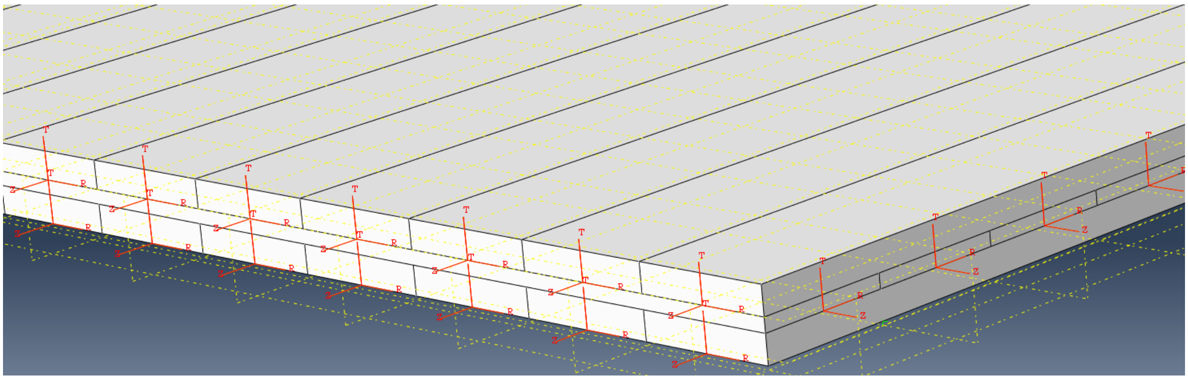


Figure 3.5: Local cylindrical coordinate system for each partition

4. Create the material(s) that are used in the CLT by using engineering constants. It is important to change the order of the constants to match the order of the local cylindrical coordinate system defined in ABAQUS. The material orientations, with properties, are defined as Radial(R) - Tangential(T) - Longitudinal(L), shown in Table 3.1.

E_R	E_T	E_L	ν_{RT}	ν_{RL}	ν_{TL}	G_{RT}	G_{RL}	G_{TL}
800	400	10000	0.6	0.04	0.024	30	600	600

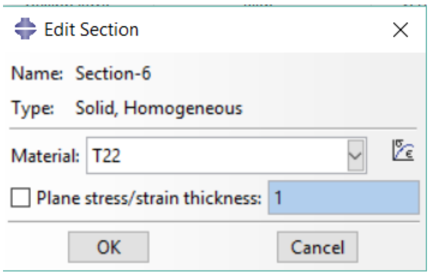
Table 3.1: Engineering constants for nordic wood, strength class T22

The material properties are swapped and placed in the order above. The poisson-ratios must be calculated to represent the correct strain relationship between the new directions. The new relationships are calculated as shown in Equation 3.1 - 3.2:

$$\nu_{RL} = \nu_{LR} \cdot \frac{E_R}{E_L} \tag{3.1}$$

$$\nu_{TL} = \nu_{LT} \cdot \frac{E_T}{E_L} \tag{3.2}$$

5. For each material in the structure, create a solid homogeneous section and define which material is used for each section.



Name: Section-6

Type: Solid, Homogeneous

Material: T22

☐ Plane stress/strain thickness: 1

Figure 3.6: Creating a solid homogeneous section

6. Apply material orientation to each partition using the local cylindrical coordinate systems created earlier. Stacking direction should be from bottom to top.

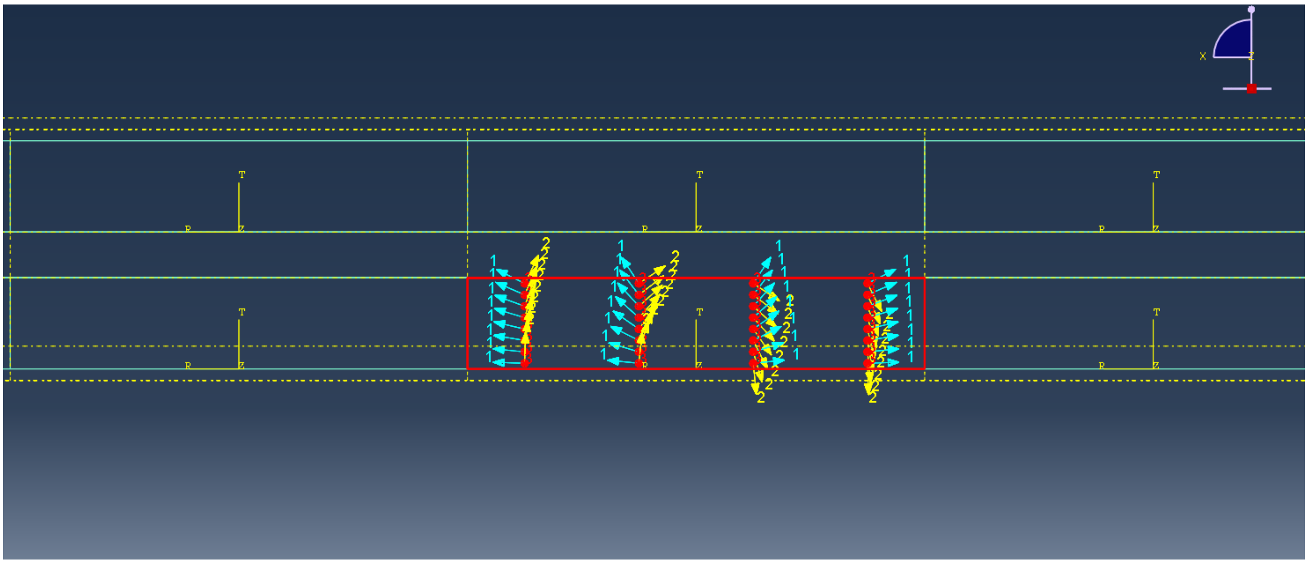
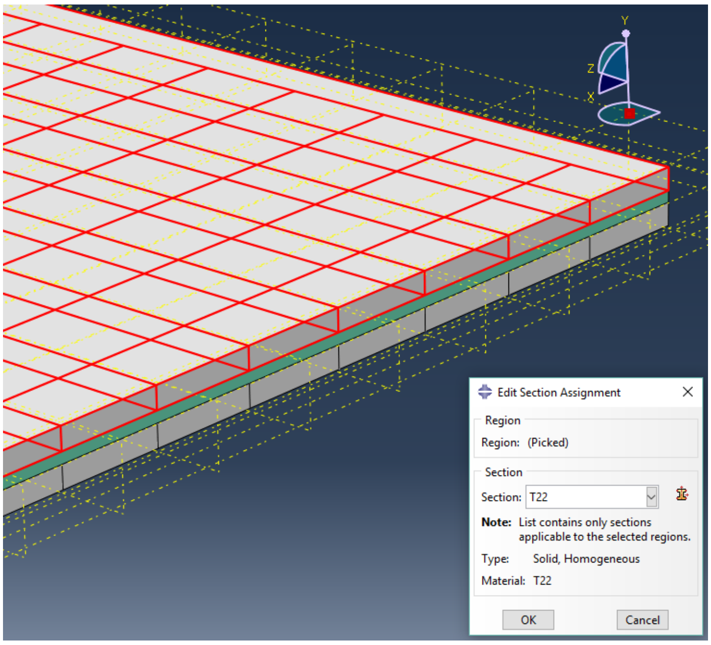


Figure 3.7: Applying the material orientation to the cylindrical coordinates

7. Apply the corresponding section, that was created earlier, to each board.



Region: (Picked)

Section: T22

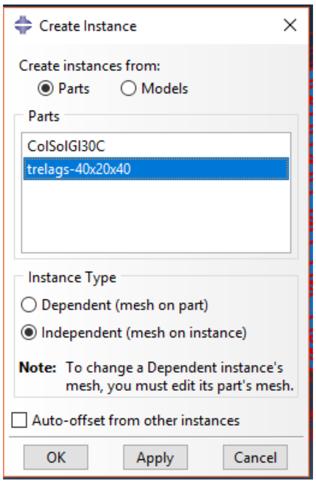
Note: List contains only sections applicable to the selected regions.

Type: Solid, Homogeneous

Material: T22

Figure 3.8: Applying corresponding sections to each board

8. Organize the part(s) into instance(s) in the assembly field, make the instance type independent.


Create Instance

Create instances from:
● Parts ○ Models

Parts
ColSolGl30C
trelags-40x20x40

Instance Type
○ Dependent (mesh on part)
● Independent (mesh on instance)

Note: To change a Dependent instance's mesh, you must edit its part's mesh.

☐ Auto-offset from other instances

Figure 3.9: Creating instance from part

9. Create as many steps as needed for the load cases.
10. Create loads, select the appropriate step and kind of load.
11. Create the appropriate boundary condition, select the step and the type of boundary condition for the structure.
12. Seed and mesh the part instance(s) with fitting size. Assign the part(s) with appropriate element types.

3.1.2 Equivalent values as described by Hans Joachim Blaß and Peter Fellmoser

In 2004, Hans Joachim Blaß and Peter Fellmoser aimed to derive a general design method for solid wood panels. For the design, they used composite theory as a footing. Stiffness and strength were determined using the basic values for each layer, taking into account parallel loading causing homogenization within the layers. With this basis, Blaß and Fellmoser proposed a strength class system in order to simplify the design of solid wood panels. The system derives characteristic strength, stiffness and density values for solid wood panels, with respect to the type of stress and direction to the outer layers [8].

For modeling of cross laminated timber, nine equivalent orthotropic material properties have to be defined. Specifically the three moduli of elasticity E_x, E_y, E_z, the three Poissons ratios v_{xy}, v_{yz}, v_{zx} and the three shear moduli G_{xy}, G_{yz} and G_{zx}. The direction of the axes for the CLT element is determined, with respect to the outer layer, like the following: Z-axis is the longitudinal direction, X-axis is the perpendicular direction and Y-axis is the direction perpendicular to the element, as shown in Figure 3.10. These properties are to be allocated on a shell element with identical length, height and thickness as the actual associated CLT element [9].

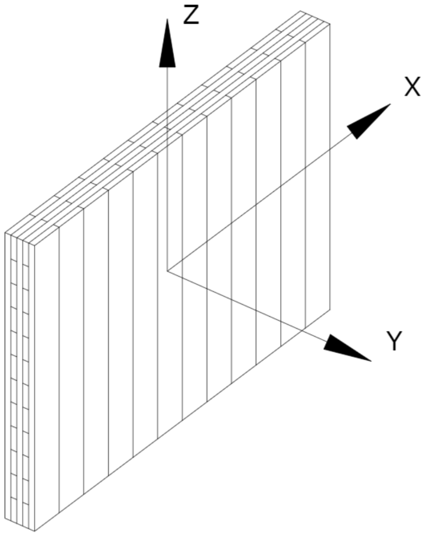


Figure 3.10: Principal axes of the CLT element

The equivalent modulus of elasticity parallel to grain of the outer layers $E_z = E_{0,eq}$ can be calculated, as suggested by Blaß and Fellmoser, from Equation 3.3 [9][8].

$$E_{0,eq} = \left[1 - (1 - \frac{E_{90,T}}{E_{0,L}}) \cdot \frac{a_3 - a_1}{a_5}\right] \cdot E_{0,L} \tag{3.3}$$

where:

$E_{90,T}$	is the modulus of elasticity perpendicular to the grain of the the transverse layers
$E_{0,L}$	is the modulus of elasticity parallel to the grain of the longitudinal layers
a_1, a_3, a_5	is the thickness as defined by Figure 3.11

Figure 3.11: a_1, a_3 and a_5 illustrated for a generic 5-layer CLT element

The equivalent modulus of elasticity perpendicular to the grain of the outer layers $E_x = E_{90,eq}$ can be calculated, as suggested by Blaß and Fellmoser, from Equation 3.4 [9][8].

$$E_{90,eq} = \left[\frac{E_{90,L}}{E_{0,T}} + (1 - \frac{E_{90,L}}{E_{0,T}}) \cdot \frac{a_3 - a_1}{a_5}\right] \cdot E_{0,L} \tag{3.4}$$

where:

$E_{90,L}$	is the modulus of elasticity perpendicular to the grain of the longitudinal layers
$E_{0,T}$	is the modulus of elasticity parallel to the grain of the transverse layers
a_1, a_3, a_5	is the thickness as defined by Figure 3.11
$E_{0,L}$	is the modulus of elasticity parallel to the grain of the longitudinal layers

The equivalent modulus of elasticity perpendicular to the element E_y can be calculated, as suggested by Blaß and Fellmoser, from Equation 3.5 [9][8].

$$E_y = t_{tot} \cdot \left[\sum_{i=1,3,..,n}^{n} \frac{t_i}{E_{90,L,i}} + \sum_{j=2,4,..,n-1}^{n-1} \frac{t_j}{E_{90,T,j}}\right]^{-1} \tag{3.5}$$

where:

t_{tot}	is the total thickness of the CLT element
t_i	is the layer thicknesses in the longitudinal direction
t_j	is the layer thicknesses in the transverse direction
$E_{90,L,i}$	is the modulus of elasticity perpendicular to the grain of the longitudinal layers
$E_{90,T,j}$	is the modulus of elasticity perpendicular to the grain of the transverse layers

Finally the shear modulus of the CLT element is calculated according to Equation 3.6.

$$G = t_{tot} \cdot \left[\sum_{i=1,3,..,n}^{n} \frac{t_i}{G_{L,i}} + \sum_{j=2,4,..,n-1}^{n-1} \frac{t_j}{G_{T,j}}\right]^{-1} \tag{3.6}$$

where:

t_{tot}	is the total thickness of the CLT element
t_i	is the layer thicknesses in the longitudinal direction
t_j	is the layer thicknesses in the transverse direction
$G_{L,i}$	is the shear modulus of the longitudinal layers
$G_{T,j}$	is the shear modulus of the transverse layers

3.1.3 Stiffness matrix

Based on Kirchhoff linear thin plate theory, the stiffness characteristics of a multilayered orthotropic plate can be defined for any type of buildup. For a "standardized" CLT buildup, see Section 2.5, each layer has its own height, material quality and grain orientation which has to be taken into account when calculating the overall stiffness of the plate. This section describes how the stiffness matrix is assembled for any given CLT panel with some simplifications.

$$D_{CLT} = \begin{bmatrix} D_{11} & D_{12} & D_{13} & 0 & 0 & D_{16} & D_{17} & D_{18} \\ & D_{22} & D_{23} & 0 & 0 & D_{26} & D_{27} & D_{28} \\ & & D_{33} & 0 & 0 & D_{36} & D_{37} & D_{38} \\ & & & D_{44} & 0 & 0 & 0 & 0 \\ & & & & D_{55} & 0 & 0 & 0 \\ & & sym. & & & D_{66} & D_{67} & 0 \\ & & & & & & D_{77} & 0 \\ & & & & & & & D_{88} \end{bmatrix} \tag{3.7}$$

Matrix 3.7 represent the full stiffness matrix of a CLT panel. The upper right part of the matrix, i.e grey/blue 3×3 submatrix, represent the eccentricity components or out of plane stiffness contribution to the matrix. Bending- and membrane elements are linked through this eccentricity, i.e. shear coupling of layers. For any CLT buildup where the laminate buildup is symmetric around the neutral axis, this part is left out. In addition when layers are oriented perpendicular to each other, $\alpha = 0°$ or $\alpha = 90°$, components which are marked blue is set to zero. These simplifications lead to Matrix 3.8.

$$D_{CLT} = \begin{bmatrix} D_{11} & D_{12} & 0 & 0 & 0 & 0 & 0 & 0 \\ & D_{22} & 0 & 0 & 0 & 0 & 0 & 0 \\ & & D_{33} & 0 & 0 & 0 & 0 & 0 \\ & & & D_{44} & 0 & 0 & 0 & 0 \\ & & & & D_{55} & 0 & 0 & 0 \\ & & sym. & & & D_{66} & D_{67} & 0 \\ & & & & & & D_{77} & 0 \\ & & & & & & & D_{88} \end{bmatrix} \tag{3.8}$$

where the flexural 3.9, shear 3.10 and membrane 3.11 stiffness contributions are divided into the following submatrices:

$$D_{flexure} = \begin{bmatrix} D_{11} & D_{12} & 0 \\ & D_{22} & 0 \\ sym. & & D_{33} \end{bmatrix} (kN \cdot m) \tag{3.9}$$

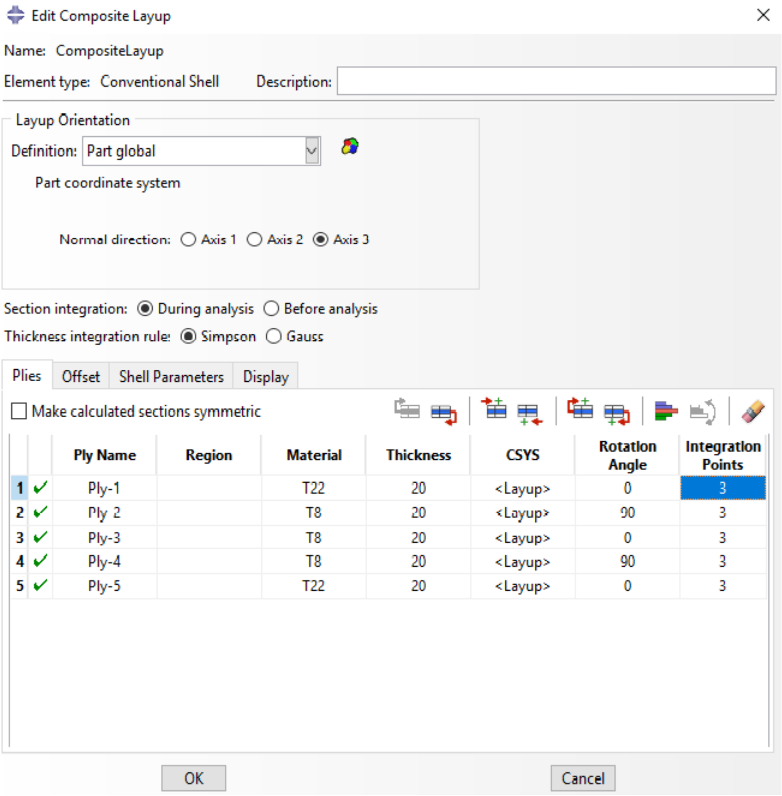
$$D_{shear} = \begin{bmatrix} D_{44} & 0 \\ 0 & D_{55} \end{bmatrix} (kN/m) \tag{3.10}$$

$$D_{membrane} = \begin{bmatrix} D_{66} & D_{67} & 0 \\ & D_{77} & 0 \\ sym. & & D_{88} \end{bmatrix} (kN/m) \tag{3.11}$$

All stiffness values are then calculated for a given CLT-buildup and used as input parameters when describing a new user-defined orthotropic section in preferred software. An example of a CLT- panel used in this thesis is described and calculated in Appendix C

3.1.4 Composite layup

By considering the CLT element as a composite element, it is possible to use a composite-layup function in order to include the stacking direction of each ply in the CLT panel. Composite layup uses conventional shell elements that only discretizes the reference layer of each ply. Each ply is then assigned its respective grain orientation and material properties. Figure 3.12 illustrates the process of dividing and assigning material properties in Abaqus.



Name: CompositeLayup

Element type: Conventional Shell

Description:

Layup Orientation

Definition: Part global

Part coordinate system

Normal direction: ○ Axis 1 ○ Axis 2 ● Axis 3

Section integration: ● During analysis ○ Before analysis

Thickness integration rule: ● Simpson ○ Gauss

☐ Make calculated sections symmetric

		Ply Name	Region	Material	Thickness	CSYS	Rotation Angle	Integration Points
1	✓	Ply-1		T22	20	<Layup>	0	3
2	✓	Ply 2		T8	20	<Layup>	90	3
3	✓	Ply-3		T8	20	<Layup>	0	3
4	✓	Ply-4		T8	20	<Layup>	90	3
5	✓	Ply-5		T22	20	<Layup>	0	3

Figure 3.12: Example of a composite layup

3.2 CLT modeling comparison

Depending on the situation, material data available, boundary conditions and desired results, a particular approach may work better than others when modeling CLT elements. A 3D approach may be appropriate when the behavior of the individual layers are of importance, or for smaller experiments where properties of details are desired. For structural analysis of a larger building, where design and member verification are of interest, a simplified and faster method of modeling CLT elements may be more favorable. In this thesis, the functional requirements are of interest. A small comparison of the methods listed above is undergone in this section, to verify and assure that the behavior of the modeling techniques are within reasonable limits. The desired result is mainly to see how the different methods compare to each other when the boundary conditions, load, dimensions and material properties are identical.

3.2.1 Comparison setup

As a CLT element is able to withstand both in- and out of plane loading, it is important that the method of modeling is versatile enough, so that it is able to describe the correct behavior for both cases. Therefore, in this comparison, two tests are performed. In the first test, bending is investigated for loading out of plane, while the second test investigated the shear displacement as a result of out of plane loading. A three and five layered CLT element is investigated.

Bending test

As a result of bending, the deflection of the panel is investigated in two set-ups. For both, a CLT element with a length of 2400 millimeters and a width of 3000 millimeters is used. A uniformly distributed load of magnitude $10\,kN/m^2$ is applied on the top of the element. The first setup consists of a simply supported CLT element in the length direction, where the outer layers are parallel to the grain. In the second set up the element is simply supported in the width direction, where the outer layers are perpendicular to the grain.

Sampling points are placed with a spacing of 400 millimeters in the length direction, and 500 millimeters in the width direction, as illustrated in Figure 3.13. The results for the displacements are then compared to each other. A simplified hand calculation based on the Timoshenko beam theory is used as a reference value for the deflection values.

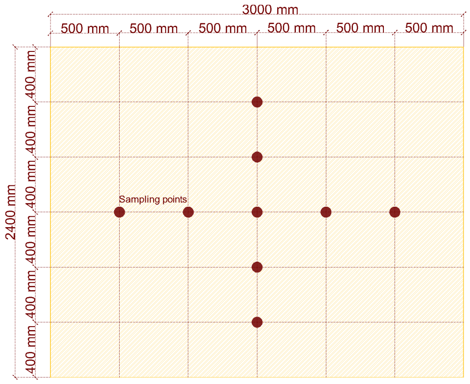


Figure 3.13: Plane view of test one, with sampling points

Shear displacement investigation

In the second test, the CLT element is fixed at one edge as illustrated by Figure 3.14. The element has a height of 2400 mm and a width of 3000 mm. A point load of 30 kN is applied at the top left corner.

One Sampling point is placed at the top right corner, see Figure 3.14. The results for the displacement at the sampling point are compared to each other. A simplified hand calculation based on the summation of the two deformation patterns, see Equation (3.15), is used as a pinpoint for the second test.

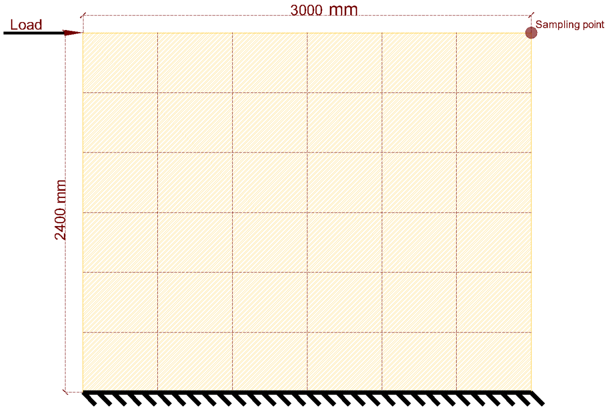


Figure 3.14: Plane view of test two, with sampling point

3.2.2 Material properties and input

Cross-section and material properties

Both a three- and five-layered CLT cross-section is inspected. For both cross-sections the outer layer material quality is T22 while the inner layers are T8, Table 3.2 presents these values. The five layered cross-section is built as: 32mm(l)-32mm(θ)-32mm(l)-32mm(θ)-32mm(l), and the three layered cross-section is 40mm(l)-20mm(θ)-40mm(l) see Figure 3.15. θ denotes a fibre direction perpendicular to grain while l denotes a fibre direction parallel to grain.

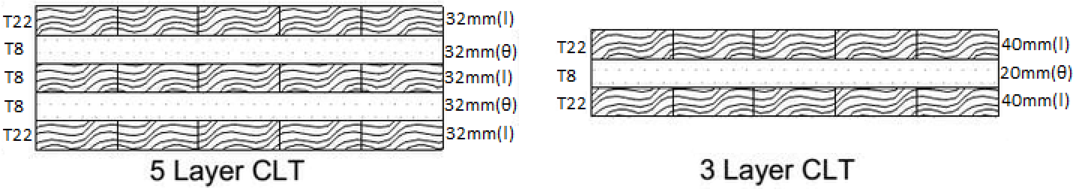


Figure 3.15: A sketch of the CLT layup used in the comparison

Material	E_1	E_2	E_3	v_{12}	v_{13}	v_{23}	G_{12}	G_{13}	G_{23}	Mass Density
T8	7000	230	230	0,39	0,49	0,64	440	440	44	350
T22	13000	430	430	0,39	0,49	0,64	810	810	81	470

Table 3.2: Material properties for T8 and T22 [5][6]

3D model with Abaqus CAE

For the 3D-model, the material properties have to be defined in the Radial(R)-Tangential(T)-Longitudinal(L) direction. Table 3.3 shows the material values used for T8 and T22 in the proper order, and Table 3.4 shows the rearranged order used in Abaqus.

Material	E_R	E_T	E_R	v_{RT}	v_{RL}	v_{TL}	G_{RT}	G_{RL}	G_{TL}	Mass Density
T8	230	230	7000	0,64	0,0131	0,0165	44	440	440	350
T22	430	430	13000	0,64	0,0131	0,0165	81	810	810	470

Table 3.3: Material properties used in the 3D-models

E_1	E_2	E_3	ν_{12}	ν_{12}	ν_{12}	G_{12}	G_{12}	G_{12}
230	230	7000	0,64	0,0131	0,0165	44	440	440
430	430	13000	0,64	0,0131	0,0165	81	810	810

Table 3.4: Input for material properties defined as Radial(R) - Tangential(T) - Longitudinal(L) for T8 and T22 respectively

Equivalent values

The equivalent values calculated, based on the CLT buildup and material qualities, are shown in Table 3.5.

Layup	$E_{0,eq} = E_1$	$E_{90,eq} = E_2$	$E_y = E_3$	v_{xy}	v_{xz}	v_{yz}	G
40-20-40	10446	3239	366	0,39	0,49	0,64	693
32-32-32-32-32	7892	5679	282	0,39	0,49	0,64	538

Table 3.5: Equivalent values used for the CLT panels

Stiffness matrix

The calculated stiffness matrix values for the cross-sections are shown in Table 3.6.

Layup	D_{11}	D_{12}	D_{22}	D_{33}	D_{44}	D_{55}	D_{66}	D_{67}	D_{77}	D_{88}
40-20-40	1075	19	69	37	12741	9733	1040000	15287	140000	51520
32-32-32-32-32	2974	21	497	131	13747	5213	992640	15287	421120	65856

Table 3.6: Layup of CLT element based on stiffness matrix

Element type and size

The element types and mesh sizes are presented in Table 3.7. C3D20R is a 20-node quadratic brick element with reduced integration. S8R is an 8-node double curved thick shell with reduced integration. S4 is a four-node quadrilateral element. The mesh sizes are held constant to minimize potential deviation in results.

Model	Element type	Global mesh size
3D solid	C3D20R	25 mm
Equivalent values	S8R	25 mm
Composite layup	S8R	25 mm
Stiffness matrix	S4	25 mm

Table 3.7: Element type and mesh size applied to the model

Timoshenko beam theory

It was decided to use the Timoshenko beam theory as a reference for test one, as it also includes shear deformation. The maximum deformation of the panel is calculated according to Equation (3.12).

$$W_{max} = \frac{5qL^4}{384E_{mid}I_{net}} + \frac{qL^2}{8S_{CLT}} \tag{3.12}$$

where:

q	is the uniformly applied load
L	is the span
E_{mid}	is the middle value of the summation of the mean values of the different layers
I_{net}	is the moment of inertia for the net cross-section

The moment of inertia for the net cross-section, I_{net}, is calculated according to Equation (3.13).

$$I_{net} = \sum_{i=1,3}^{n} \frac{b \cdot t_i^3}{12} + (b \cdot t_i \cdot a_i^2) \tag{3.13}$$

where:

S_{CLT}	is the shear stiffness of the cross- section
t_i	is the thickness of layer i
b	is the width of the cross-section
a_i	is the distance from neutral axis of cross-section to center of layer i

The shear stiffness is needed for out of plane loading, and can be calculated with Equation (3.14).

$$S_{CLT} = \kappa \sum_{i=1}^{n} (G_i \cdot b \cdot t_i) \tag{3.14}$$

where:

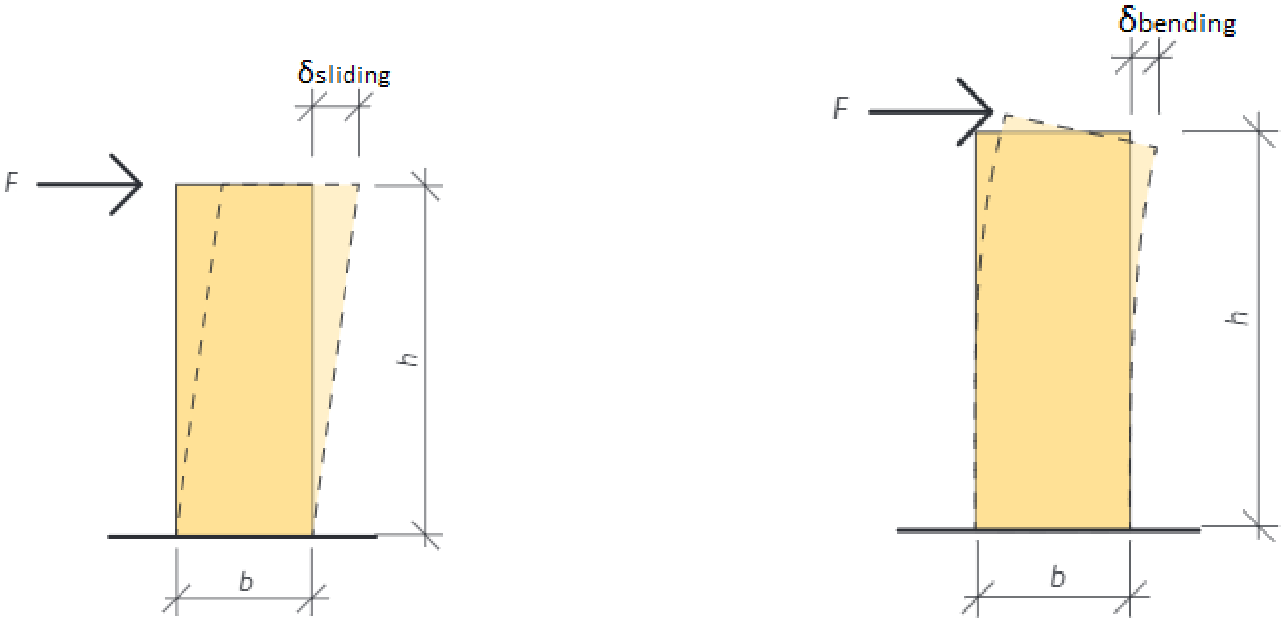
κ is the shear correction factor
G_i is the shear modulus of layer i
b is the width of the cross-section
t_i is the thickness of layer i

Due to the different shear and elasticity modulus for the layers in a CLT cross-section, the shear correction factor, κ, is applied to Equation (3.14). The recommended κ values for a 100 mm and 160 mm thick CLT-element are $\kappa = 0,196$ and $\kappa = 0,201$, respectively [35].

Summation of deformation patterns

For the second test, it is possible to express the total horizontal displacement of the CLT element in a simplified manner as shown in Equation (3.15) [35].

$$\delta_{tot} = \delta_{sliding} + \delta_{bending} \tag{3.15}$$



(a) $\delta_{sliding}$ (b) $\delta_{bending}$

Figure 3.16: Deformation pattern in shear and bending, respectively

The deformation due to transverse forces, $\delta_{sliding}$, see Figure 3.40a, can be expressed according to Equation 3.16 [35].

$$\delta_{sliding} = \frac{F \cdot h}{b \cdot t_{tot} \cdot G_{mean}} \tag{3.16}$$

where:

F	is the applied force
h	is height of the CLT element
G_{mean}	is shear modulus of the CLT element
t_{tot}	is the total thickness of the CLT element

The deformation due to moment, $\delta_{bending}$, see Figure 3.40b, can be expressed according to Equation 3.17[35].

$$\delta_{bending} = \frac{F \cdot h^3}{3 \cdot E_{mean} \cdot I} \tag{3.17}$$

where:

E_{mean}	is elasticity modulus of the CLT element
I	is the moment of inertia of the CLT element
h	is the height of the element

3.2.3 Results

Bending test - first set-up

The displacements values at the sampling points in the bending test, for the first configuration, are listed in Table 3.8. Graphical visualization of these results are shown in Figure 3.17 and Figure 3.18 respectively. All values are presented in mm.

Configuration 1	Method	SP 1	SP 2	SP 3	SP 4	SP 5
3 layer CLT	3D solid	2,43	4,10	4,69	4,10	2,43
	Equivalent values	2,47	4,23	4,87	4,23	2,47
	Stiffness matrix	2,42	4,10	4,70	4,10	2,42
	Composite layup	2,78	4,68	5,36	4,68	2,78
	Timoshenko			4,75 + (0,52)*		
5 layer CLT	3D solid	1,01	1,63	1,85	1,63	1,01
	Equivalent values	0,91	1,56	1,80	1,56	0,91
	Stiffness matrix	1,03	1,74	1,99	1,74	1,03
	Composite layup	1,04	1,73	1,97	1,73	1,04
	Timoshenko			1,70 +(0,44)*		

Table 3.8: Vertical displacement at sampling points, configuration 1

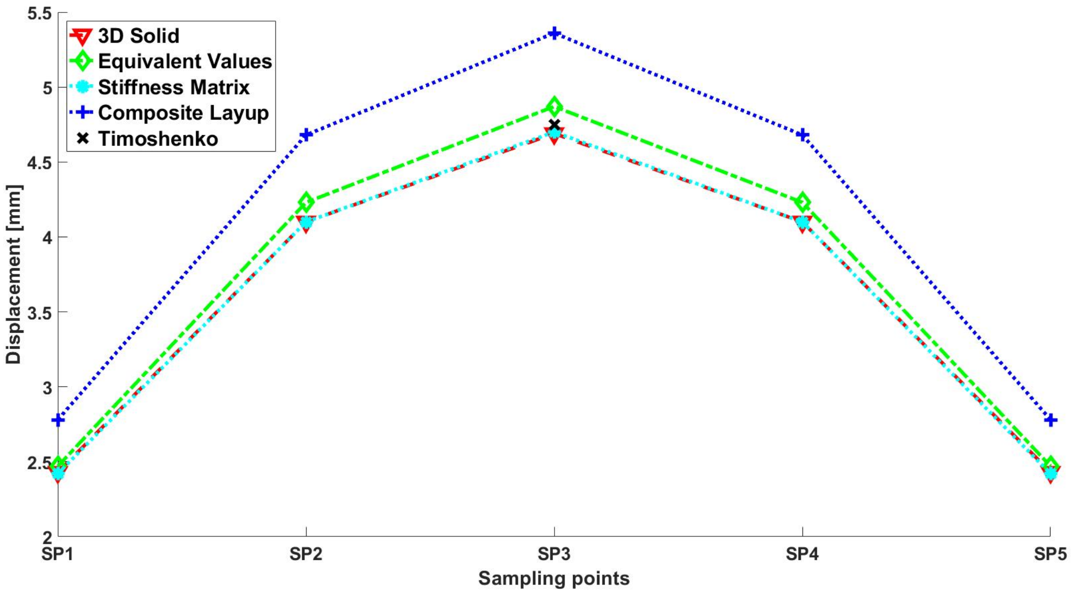


Figure 3.17: Configuration 1 with three-layer CLT cross-section

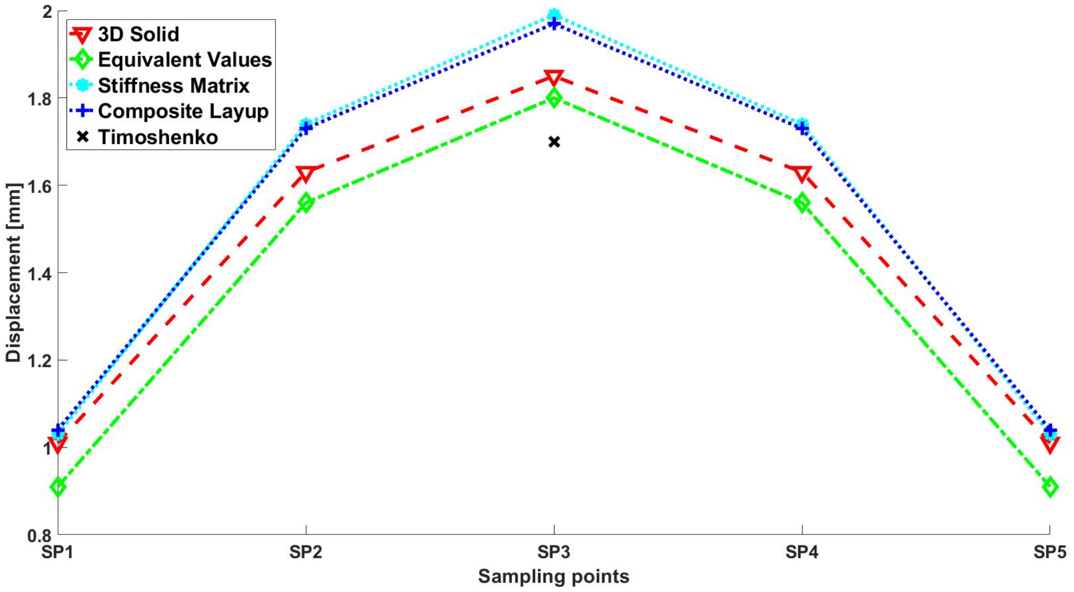


Figure 3.18: Configuration 1 with five-layer CLT cross-section

Bending test - second set-up

The displacement values at the sampling points in the bending test, for the second configuration, are listed in Table 3.9. Graphical visualisation of these results are shown in Figure 3.19 and Figure 3.20 respectively. All values are presented in mm.

Configuration 2	Method	SP 1	SP 2	SP 3	SP 4	SP 5
3 layer CLT	3D solid	149,36	256,73	295,63	256,73	149,36
	Equivalent values	11,70	20,10	23,10	20,10	11,70
	Stiffness matrix	78,10	133,90	154,00	133,90	78,10
	Composite layup	132,78	227,78	262,31	227,99	132,78
	Timoshenko			1438,20 + (1,20)*		
5 layer CLT	3D solid	9,44	16,04	18,42	16,04	9,43
	Equivalent values	2,46	4,22	4,85	4,22	2,46
	Stiffness matrix	11,92	20,33	23,35	20,33	11,92
	Composite layup	9,52	16,24	18,65	16,24	9,52
	Timoshenko			15,80 + (2,10)*		

Table 3.9: Vertical displacement at sampling points, configuration 2

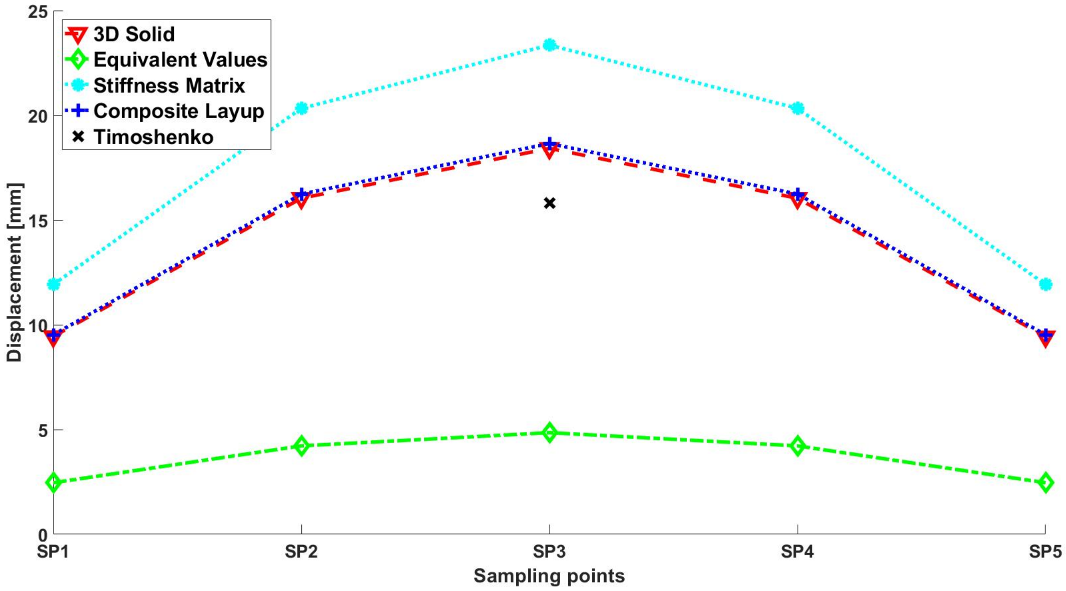


Figure 3.19: Configuration 2 with three-layer CLT cross-section

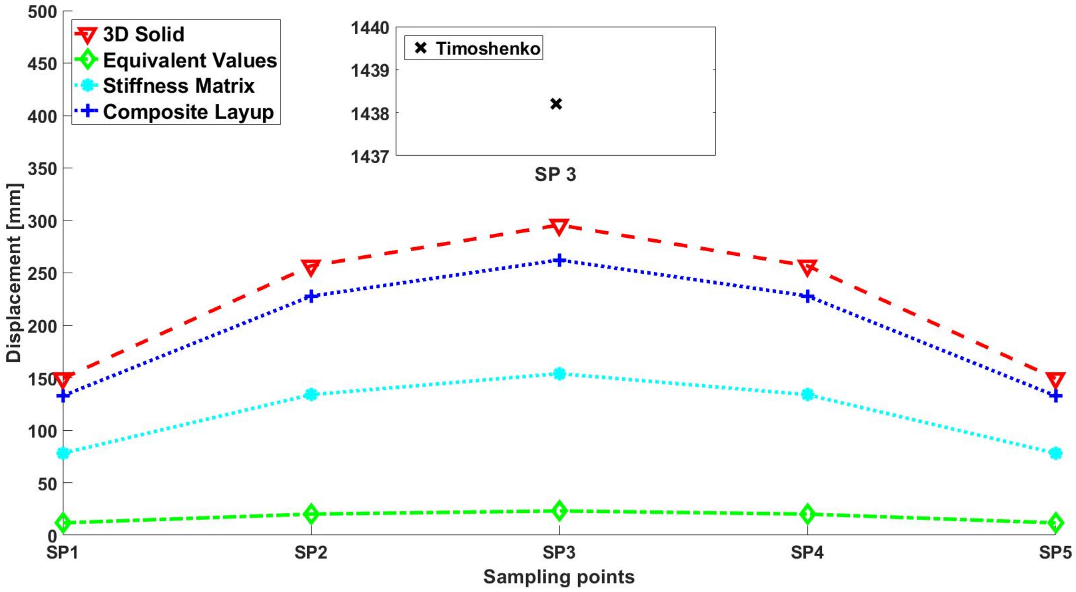


Figure 3.20: Configuration 2 with five-layer CLT cross-section

Shear test

The displacements at the sampling point in the shear test for both three- and five-layer CLT cross-sections are listed in Table 3.10. All values are presented in mm.

	Method	SP 1
3 layer CLT	3D solid	0,485
	Equivalent values	0,4825
	Stiffness matrix	0,943
	Composite layup	0,477
	t_{tot}	0,544
5 layer CLT	3D solid	0,3799
	Equivalent values	0,3793
	Stiffness matrix	0,341
	Composite layup	0,373
	t_{tot}	0,504

Table 3.10: Horizontal displacement at the sampling point for test two for both three- and five-layer CLT cross-sections

3.2.4 Conclusion - modeling comparison

As seen in the results from Section 3.2.3, there is a certain level of compliance between the computed displacement values of the four modeling techniques. All of the four techniques are given as recommendations by various publishers and have not undergone any extensive testing of various layouts or configurations, as far as authors of this thesis are aware of.

Configuration 1 was undergone with nodal displacement results well within 10 percent of each other at the midspan of the panel. All of the methods yielded displacements that were relatively close to - or above the compared Timoshenko values, which indicates that all four modeling approaches display sufficient flexibility.

For the three-layered cross-sections, the composite method is the most flexible and strays the furthest away from the average displacement. The stiffness matrix and 3D approach give almost indistinguishable displacements with somewhat stiffer results than the Timoshenko simplification. The equivalent value practice can be seen as a good middle value for both the most and least flexible solution, yet still close enough to the average. In the five-layered sections, all the modeling proposals display a close link to the average. At this time, however, the composite layup and stiffness matrix are almost identical, while also being the most flexible. The equivalent value method appears to be the stiffest, while also being the closest to the hand calculations based on Timoshenko beam theory.

Questions arise when displacements in Configuration 2 are compared. The "faulty" and misleading results by Timoshenko can be explained by the exclusion of outer and middle layers for the three- and five-layered buildups. Leaving out the transverse layers and their contribution to the overall stiffness, the panels become overly flexible as their fictitious cross-sections are left out with only one and two plies. The vast variety in displacements shows that all four methods fail and over-predict the displacements when a panel is loaded out of the plane and supported unfavorably. The five-layered CLT cross-section is somewhat within an average, except the "Equivalent values" which is significantly lower than the other results.

For the second test, i.e shear test, all of the methods show a very close average to each other. The panels behave stiffer than the simplified hand calculation, which is expected as the hand calculations include some notable simplifications. For a three-layered cross-section, the stiffness matrix is the only method that shows a surprisingly high displacement and stands out from the rest.

Based on the comparisons and results, there seem to be no advantages in using a detailed 3D- model compared to the other modeling techniques presented above. Unless the user is curious about the detailed behavior of each ply in the CLT panel, as it can be meshed and analyzed individually in a 3D- model, the overall stiffness of all CLT panels and its contribution to a global system seems reliable. For this thesis, it was decided to use the equivalent value method, as it gives sufficient results while requiring a fraction of the modeling and computational time. The stiffness matrix approach was early on considered unusable, due to its lack of incompatibility with the structural modeling software SAP2000. Another reason was the unpredictable and deviating results from several of the tests performed.

3.3 CLT thickness comparison

Based on the requirements and restrictions of a project, determining appropriate dimensions for a CLT wall element may be a complicated procedure. Thinner plies and therefore cheaper CLT elements are often good enough with respect to the ultimate limit state, while one of the deciding factors is the requirements for the serviceability limit state. Some of these requirements are harder to fulfill for timber elements and buildings, especially the vibrations, displacements, and accelerations criterion. As for all buildings, there are more parameters that affect the global stiffness of the structure than just a shear wall. The connection method for the shear wall and fastener properties are especially important in timber structures. To get a better understanding of how the different CLT layups and layer thicknesses affect the global stiffness, a small comparison of CLT layups are tested with differentiating stiffness values for the connections. The desired outcome is to see how the different layups compare to each other, and how the stiffness of the connection and CLT element interact with each other. This comparison will also be used as a foundation for deciding which layup and thickness of the CLT panel that is going to be used for the experiment.

3.3.1 Comparison setup

The investigation was carried out on a simple 2D- frame, as a simplification for a story in a larger building. Two glulam columns were used with a height of 3200 millimeters. They were connected together with a CLT panel with a height of 3000 millimeters and a length of 2400 millimeters. The CLT element is modeled as a shell element, with the use of equivalent values for the material properties. A total of eight CLT buildups are investigated. The outer layers are parallel with the length direction. The fasteners, tying together the panel and columns, are modeled as semi-rigid links with the proper stiffness values and no length. The frame is exposed to a concentrated compression force of 10 kN at the top left corner, and horizontal displacements are sampled 50 millimeters above the CLT element, see Figure 3.21 for clarification. For each CLT layup, the number of fasteners is increased throughout the simulation.

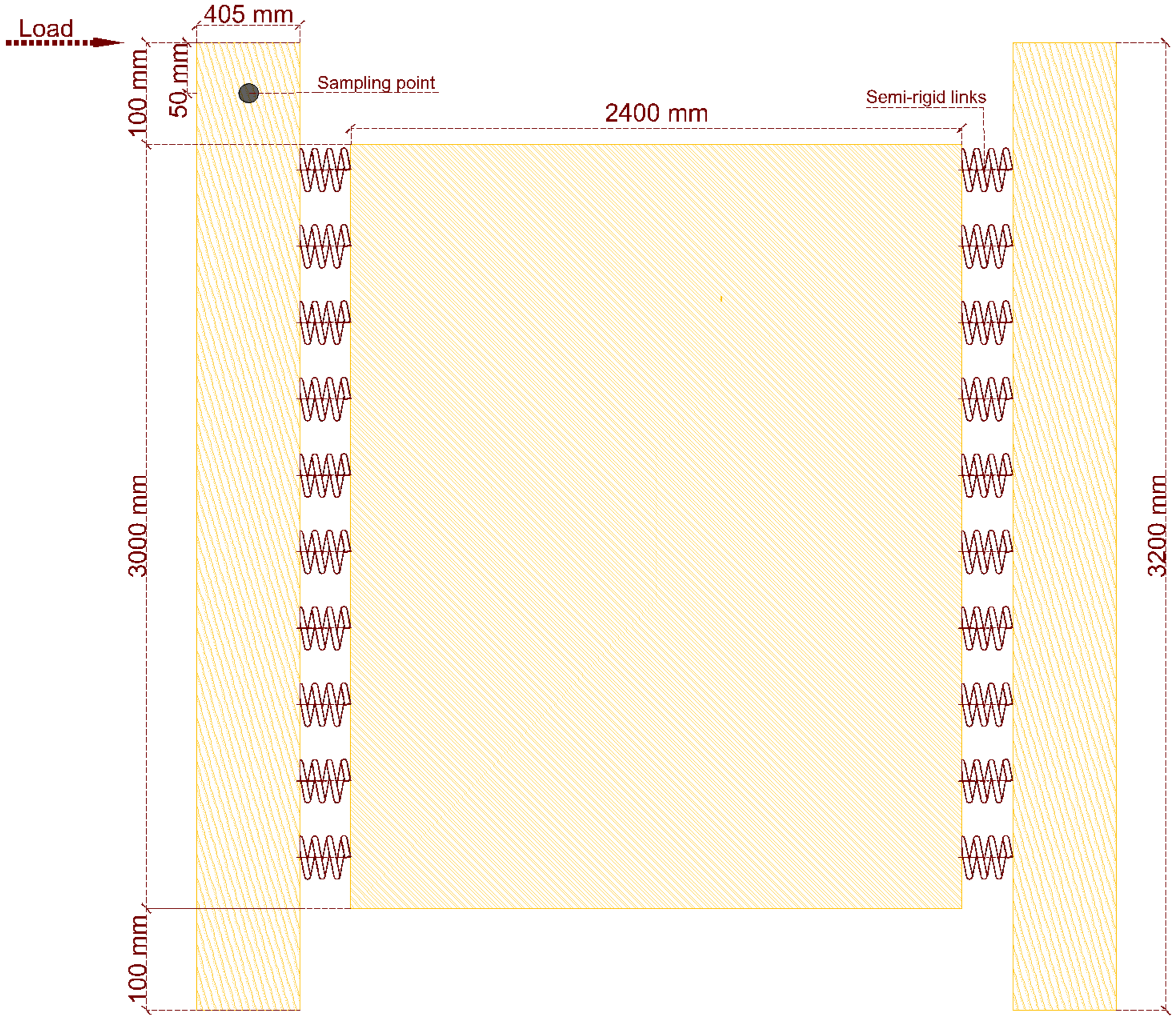


Figure 3.21: Sketch of the test configuration

3.3.2 Material properties and input

Eight different CLT configurations are inspected, four three-layered and five-layered CLT panels. For all cross-sections the outer layer material properties are T22 while the inner layers are T8, see Table 3.2. The fiber orientation is parallel to the length direction in the outer layers and perpendicular for the middle layers, see Figure 3.15. The columns are of quality GL30C and have the dimensions 405x450 mm, see Table 3.11.

Material	E_1	E_2	E_3	v_{12}	v_{13}	v_{23}	G_{12}	G_{13}	G_{23}	Mass Density
GL30C	13000	300	300	0,39	0,49	0,64	650	650	65	0

Table 3.11: Material properties for GL30C [5][6]

The chosen dimensions of CLT layups were determined based on the stock of a local manufacturer and the standard dimensions they were producing. Table 3.12 lists the layups that were investigated.

Type	layer thickness [mm]
Three-layer CLT	20-20-20 30-20-30 33,3-33,3-33,3 45-45-45
Five-layer CLT	20-20-20-20-20 40-20-40-20-40 32-32-32-32-32 40-40-40-40-40

Table 3.12: Standard dimensions being produced by the local manufacturer

The equivalent values calculated for all the plates and allocated on the shell element are shown in Table 3.13

Configuration [mm]	$E_{0,eq} = E_1$	$E_{90,eq} = E_2$	$E_y = E_3$	v_{xy}	v_{xz}	v_{yz}	G
20-20-20	8743	4866	333	0,39	0,49	0,64	633
30-20-30	9808	3849	353				669
33,3-33,3-33,3	8743	4866	333				633
45-45-45	8743	4866	333				633
20-20-20-20-20	7195	6345	277				528
40-20-40-20-40	9808	3849	300				570
32-32-32-32-32	7892	5679	283				538
40-40-40-40-40	7892	5679	283				538

Table 3.13: Equivalent values calculated for each cross- section

The semi-rigid links are only assigned dowel stiffness. No axial stiffness is taken into account, and the increased stiffness is due to an increase in the number of fasteners per column. The fastener properties used are shown in Table 3.14. The density used in the Eurocode 5 formula is ρ_m = 450 kg/m3.

Density [kg/m^3]	diameter[mm]	Kser [N/mm]
450	10	4144

Table 3.14: Dowel stiffness, Kser, used in the test

3.3.3 Results

Three-layer cross-sections

The sampled displacements from the tests with three-layer cross-sections are shown in Table 3.15. All displacement values are presented in mm.

Fasteners	20-20-20	30-20-30	33,3-33,3-33,3	45-45-45
4	10,11	9,59	9,31	9,00
10	4,76	4,53	4,44	4,32
20	3,06	2,88	2,81	2,71
40	1,94	1,77	1,72	1,64
60	1,54	1,39	1,33	1,25
80	1,29	1,15	1,10	1,02
100	1,20	1,05	1,00	0,91
120	1,13	0,97	0,91	0,83
150	1,05	0,89	0,83	0,75
160	1,04	0,87	0,81	0,73
180	1,01	0,84	0,78	0,69
200	0,99	0,82	0,75	0,66
300	0,88	0,71	0,65	0,56
400	0,83	0,66	0,60	0,51
600	0,77	0,60	0,54	0,45
800	0,74	0,57	0,51	0,42
1000	0,72	0,55	0,49	0,40
2000	0,68	0,51	0,45	0,36
INF	**0,5826**	**0,4245**	**0,3689**	**0,2847**

Table 3.15: Horizontal displacement for three-layer cross-sections with respect to number of fasteners

Five-layer cross-sections

The sampled displacements from the tests with five-layer cross-sections are shown in Table 3.16. All displacement values are presented in mm.

Fasteners	20-20-20-20-20	40-20-40-20-40	32-32-32-32-32	40-40-40-40-40
4	9,45	8,94	8,95	8,78
10	4,51	4,29	4,31	4,24
20	2,87	2,68	2,70	2,65
40	1,77	1,62	1,63	1,59
60	1,38	1,23	1,25	1,20
80	1,15	1,01	1,02	0,98
100	1,05	0,90	0,91	0,86
120	0,97	0,81	0,83	0,78
150	0,89	0,73	0,74	0,69
160	0,87	0,71	0,72	0,67
180	0,84	0,67	0,69	0,64
200	0,81	0,64	0,66	0,61
300	0,71	0,54	0,56	0,51
400	0,66	0,49	0,50	0,45
600	0,60	0,43	0,45	0,39
800	0,57	0,40	0,41	0,36
1000	0,55	0,38	0,40	0,34
2000	0,51	0,34	0,35	0,30
INF	**0,4226**	**0,2625**	**0,2806**	**0,2326**

Table 3.16: Horizontal displacement for five-layer cross-sections with respect to number of fasteners

Visual representation

A visual representation of the results from both three- and five-layered cross-sectional tests are shown in Figure 3.22.

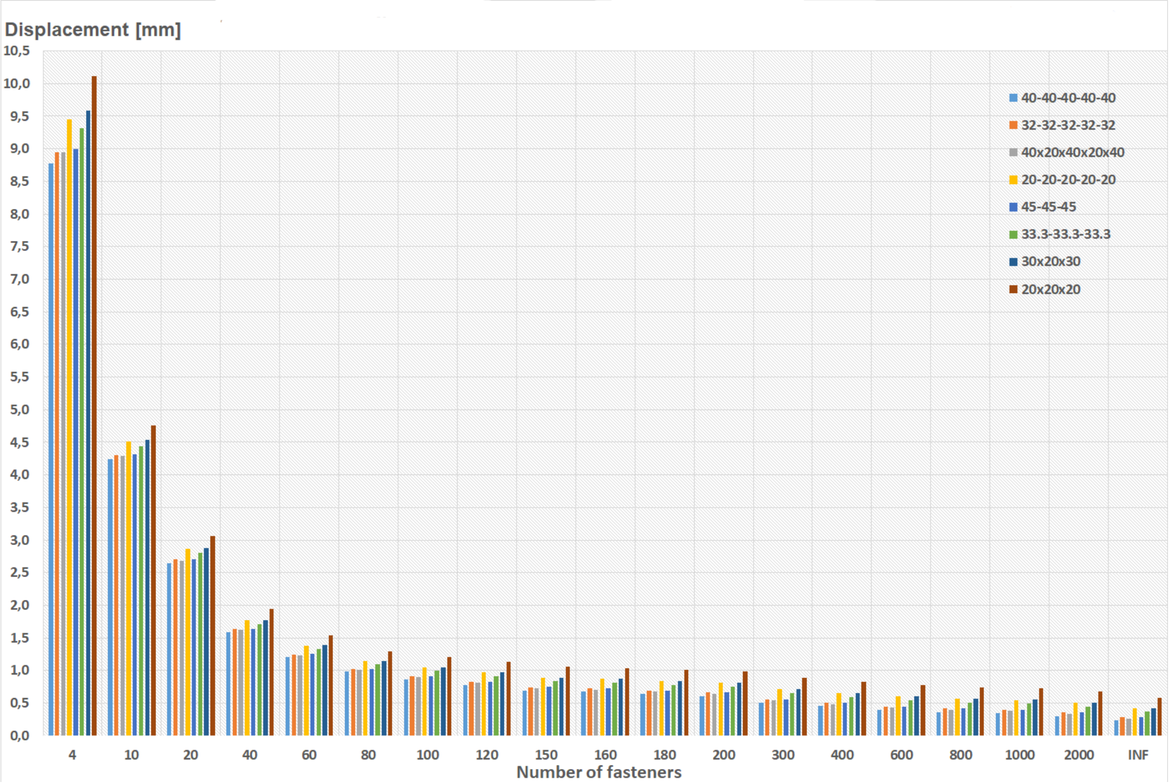


Figure 3.22: A visual representation of the horizontal displacements with respect to the number of fasteners

3.3.4 Conclusion

From the comparisons, it can be observed that for a simple frame, an increase in the thickness of the cross-sections has a somewhat negligible effect compared to the number of fasteners used. The horizontal displacement, for a small scale system, is then concluded to solely be governed by the number of fasteners. To ensure that the design follows practicable construction methods, it was decided to observe the range between a total of 100 to 200 fasteners, which is the most probable number of fasteners to be used with respect to practicality. An increase in the number of fasteners from this point up to an "infinite" amount was taken into consideration to show that the displacement converges to a certain number.

By examining the equivalent value approach to calculate the stiffness of a CLT panel, it is evident that only the layers parallel to the loading are considered its main resistance. Theoretically, the most optimal design would then be a cross-section with minimal layer thickness perpendicular to the load direction. Therefore, numerically, a cross-section i.e 40-20-40 mm would be much stiffer than 33,3-33,3-33,3 mm in the load direction. However manufactures rarely have these layups in stock, as it is a special circumstance where they would be favorable compared to a plate that can be loaded in two directions.

The cross-section 33,3-33,3-33,3 mm was chosen to be used in the upcoming experiment because of its performance in the tests. The performance was close to the 45-45-45 mm cross-section while having a 35 percent smaller thickness. The results were also competitive compared to the larger five-layer cross-sections.

3.4 Fastener comparison

3.4.1 Fastener characteristics

Connecting a CLT pane to the outer parts of the columns in a structure can be done with numerous solutions, and there are a vast number of different fasteners produced by various manufacturers. This thesis is limited to use screws as a fastener type and if inclination, diameter, embedding length, and positioning is left open as variables to adjust, there are endless combinations to choose from.

Eurocode 5 limitations and requirements

Eurocode 5 allows for an angle between the screw axis and the grain direction to be no lower than 30 degrees [27]. As angles are defined, in this thesis, from a reference point perpendicular to the reference plane, see Chapter 2.6, this would limit the applicable range for the screws from 0 to 60 degrees inclination, see Figure 2.14.

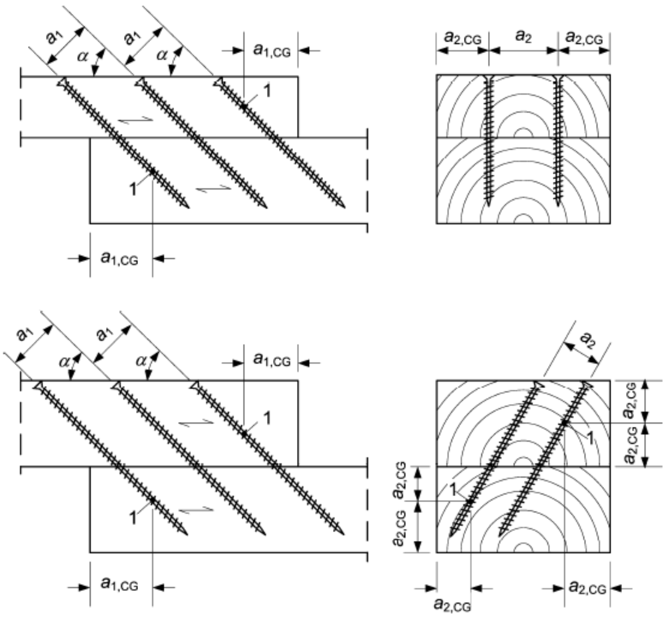
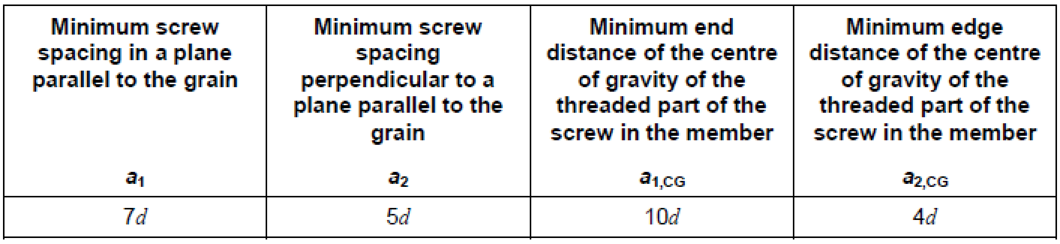


Figure 3.23: Spacing, end - and edge distances

Minimum spacings become a frequently discussed subject when figuring out how the desired screws should be spread out on the designated area, 405 mm width, of the columns. Eurocode 5 includes both requirements for transversely and axially loaded screws but has no information when the screw becomes a combination of both. As a conservative approach, minimum distances for axially loaded screws are chosen as the minimum requirements to be fulfilled. Eurocode 5 outlines the minimum spacing, edge - and end distances for axially loaded screws in the range of 6 mm ≤ d ≤ 12 mm, see Figure 3.23 and Figure 3.24 [27].



Minimum screw spacing in a plane parallel to the grain a_1	Minimum screw spacing perpendicular to a plane parallel to the grain a_2	Minimum end distance of the centre of gravity of the threaded part of the screw in the member $a_{1,CG}$	Minimum edge distance of the centre of gravity of the threaded part of the screw in the member $a_{2,CG}$
$7d$	$5d$	$10d$	$4d$

Figure 3.24: Minimum spacing, end - and edge distances for axially loaded screws between 6 and 12 mm

Supervisor recommendations and manufacturers product range

The only parameters that were discussed and recommended by the supervisors was a maximum angle of 45 degrees and preferably at least two fasteners per row. Higher angles will lead to difficulties when inserting the screws into the CLT panel, while multiple fasteners per row will take care of the moment introduced by the forces from the columns. Furthermore, Rothoblaas was chosen as the main producer of screws for this project. Two of their products are the VGS and the WRT- threaded wood screw with a lot of the similar properties, some are copied from their product catalog, shown in Table 3.17 below:

Product name	Diameter [mm]	Length [mm]	Product code
VGS	9	160-360	VGS9-xxx
	11	100-600	VGS11-xxx
WRT	9	250-500	WRT9-xxx
	13	400-1000	WRT13-xxx

Table 3.17: Rothoblass product characteristics

Practical analysis

The chosen screws have a variety of lengths to be chosen from. Figure 3.25, and an Excel spreadsheet was created as a tool for detailed analyses of length and angle while also being helpful for creating an assembly layout. It was decided to focus on the 11 mm VGS screws, as 13 mm is outside the Eurocode 5 range of validity for spacing, and the supervisor recommended a larger diameter than 10 mm. The most important values to gather from Figure 3.25, to check if the length and angle are agreeable with Eurocode 5 are *a2,cg2,screw2* and *L8*. *a2,cg2,screw2* gives a quick insight if the center of gravity of the second screw is within the end distance allowed in the code for the penetrated member i.e the column. However, even if *a2,cg2,screw2* is within the limits, *a2,cg*, the tip of the second screw, might extend beyond the penetrated member if the angle is too steep, or the screw is too long. Values of *L8* will indicate if this happens.

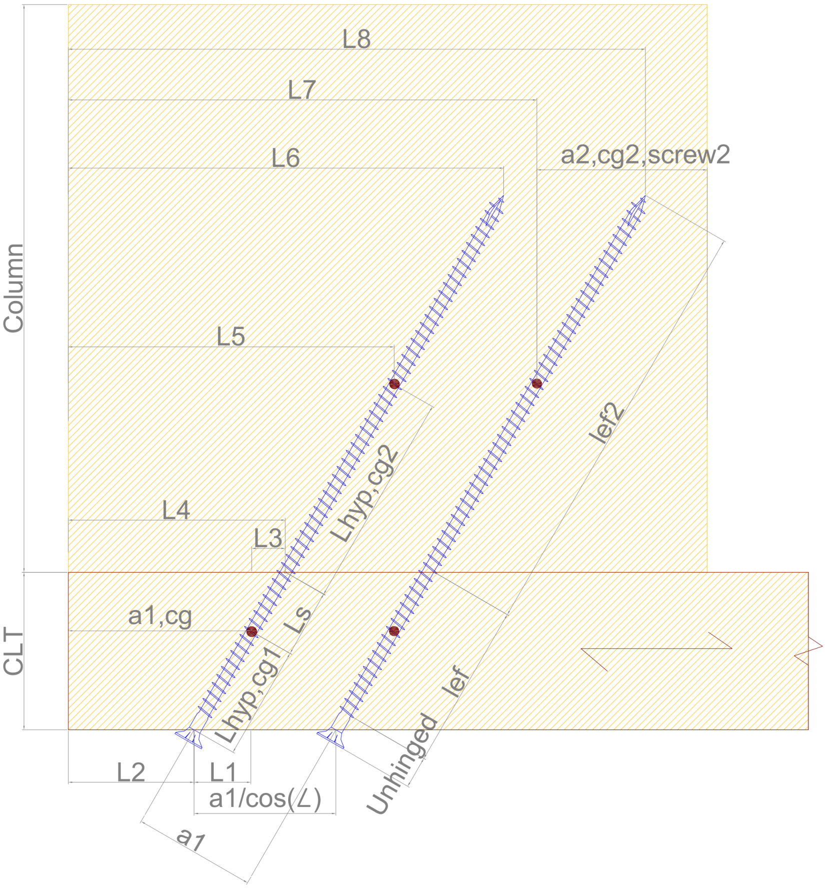


Figure 3.25: Screw layout with respect to Eurocode requirements

A quick summary of the study is shown in Table 3.18. It shows the maximum angle for a diameter of 11 mm and different lengths, for a row with two screws.

Length[mm]	100	150	200	250	300	350	400	450	500	550	600
Maximum degree of angle	60	60	60	58	52	43	36	31	28	25	23

Table 3.18: The maximum angle allowed for lengths of VGS 11mm screw

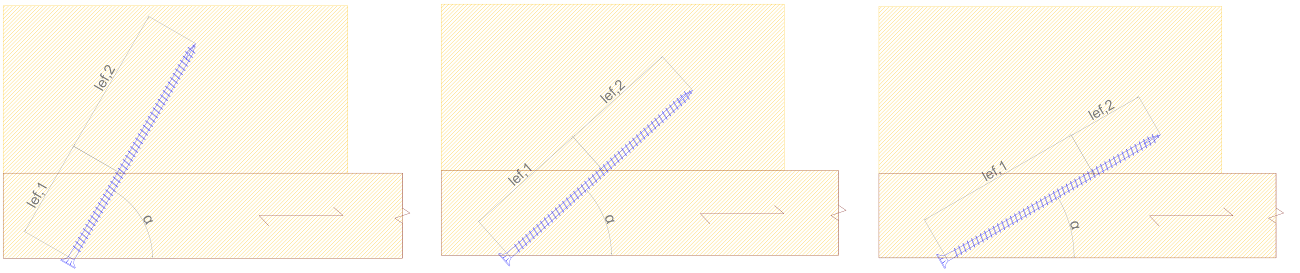
Numerical analysis

The screw and its diameter were then studied and tested numerically for various types of inclination. Ranging from 0 to 45 degrees, the formulas from Chapter 2.6 were applied and the axial stiffness was incorporated to the total stiffness of the screw. Equation 2.11 is used to calculate the axial stiffness of the self-tapping screws. The friction coefficient is left out of Equation 2.8 due to moisture adjustment in the two adherent parts after installment. Desorption in the cell walls causes shrinkage in both the CLT panel and the column, which in the end creates a tiny gap between the two adherent parts. With this conservative approach in mind, some results of the inclinations studied are listed in Table 3.19.

Inclination [deg]	Axial stiffness [N/mm]	Total stiffness [N/mm]	% tot. stiffness increase
0	7950	4558	0
5	7962	4584	0,57
10	7999	4662	1,70
15	8061	4793	2,81
20	8150	4978	3,86
25	8269	5221	4,88
30	8421	5524	5,80
35	8611	5891	6,64
40	8845	6329	7,44
45	9132	6845	8,15

Table 3.19: Angle and total stiffness comparison

A steady increase in the total stiffness is seen throughout the whole study of inclination. The total fastener stiffness reaches its theoretical maximum of 9000 N/mm for a 400 mm long screw inserted close to 60 degrees. With this configuration, the embedment length in both the CLT panel and the column becomes equal, i.e 200 mm. As illustrated in Figure 3.26, the minimum of the two $l_{ef,i}$ are set into Equation 2.11.



(a) lef,1<lef,2 (b) lef,1=lef,2 (c) lef,1>lef,2

Figure 3.26: Screw angle comparison

3.4.2 Conclusion and layout design

The in-depth fastener study is undergone from a practical standpoint. To ensure that all variables in the study are within range of reasonable applicability, minimum distances are rounded up to even numbers and the fastener length is chosen to be on the safe side. A 11x400 mm threaded self-tapping VGS screw was chosen to be used in the experiment. As Table 3.18 illustrates, the maximum angle should be no greater than 36 degrees when installing these types of screws. To be reasonable and realistic regarding the assembly process, 30 degrees was selected as the inclination of the screws for the experiment. This gives an approximate of 5500 N/mm as total stiffness for each fastener. 5500 N/mm is a middle value that takes into consideration a deviation of ± 4-5 degrees in installment error.

The CLT panel is divided vertically with a distance of 100 mm, leaving 23 pairs of fasteners to be equally spaced out. The width of the columns, 405 mm, allows for multiple fasteners, but to ensure that minimum distances are fulfilled, each row is left with only two screws. To take advantage of the width of the column, a row is then mirrored vertically and placed with an offset of 50 mm to the previous row. Figure 3.28 illustrates the final configuration for the fasteners. Figure 3.27 illustrates the placement of the screws seen from above, the mirrored rows are depicted in gray. The layout is applied to all three columns. The fasteners are divided into groups, i.e A1, A2, A3, A4 and A5. The groups indicate the order of the assembly process. The partitioning of the screws is done in order to verify the effectiveness of the placement of fasteners, as theory suggests that the most effective fasteners are the ones placed with the greatest distance from the neutral axis, i.e group A1 and A2.

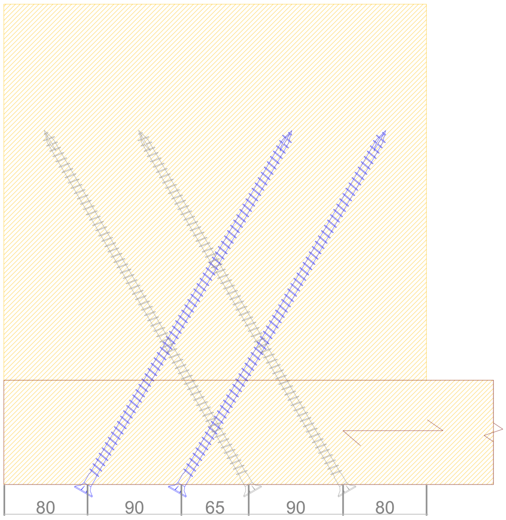


Figure 3.27: Final screw layout used in all of the columns

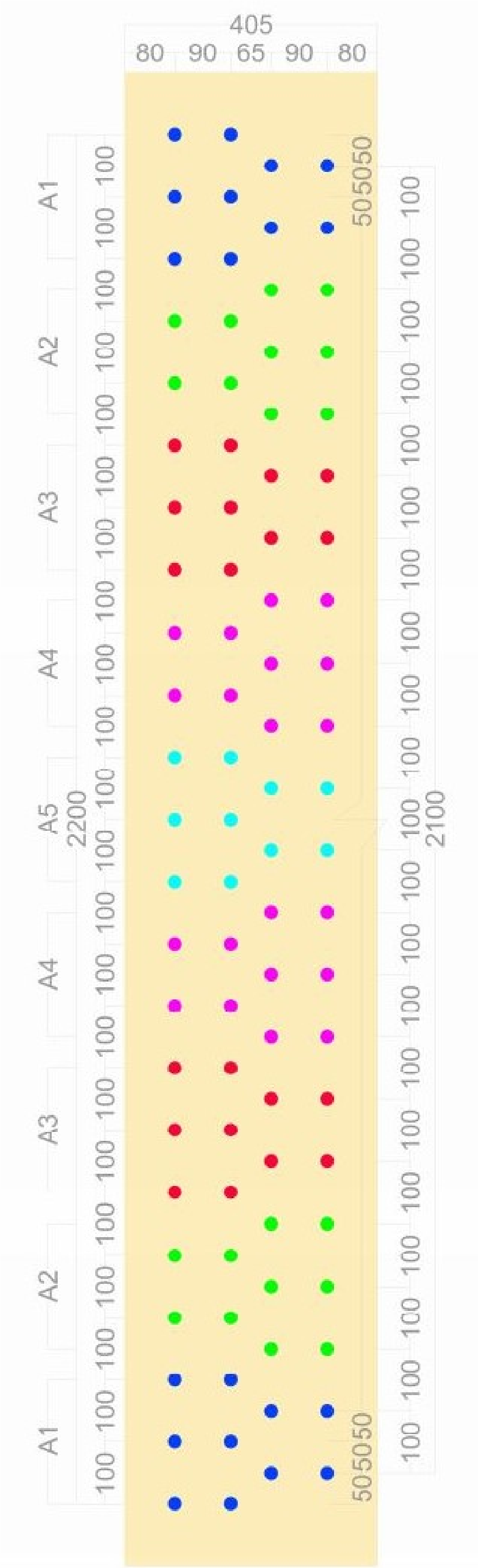


Figure 3.28: Labels applied to screw groups

3.5 Numerical model

3.5.1 Mock up at Charlottenlund

In conjunction with WoodSol, the Department of Structural Engineering at NTNU has been allowed, by the school board of Charlottenlund videregående Skole, to build a 1:1 scale mock-up at their facilities. The mock-up is built using the principle of moment resisting frames spanning in the y-direction. Furthermore, the whole assembly consists of two-floor elements and six columns, as depicted in Figure 3.29.

Figure 3.29: Mock up at Charlottenlund VGS

The layout for the mock-up is seen in Figure 3.30. The bottom of the slabs are located at a height of 2000 mm, and the total height of the columns is 5038 mm.

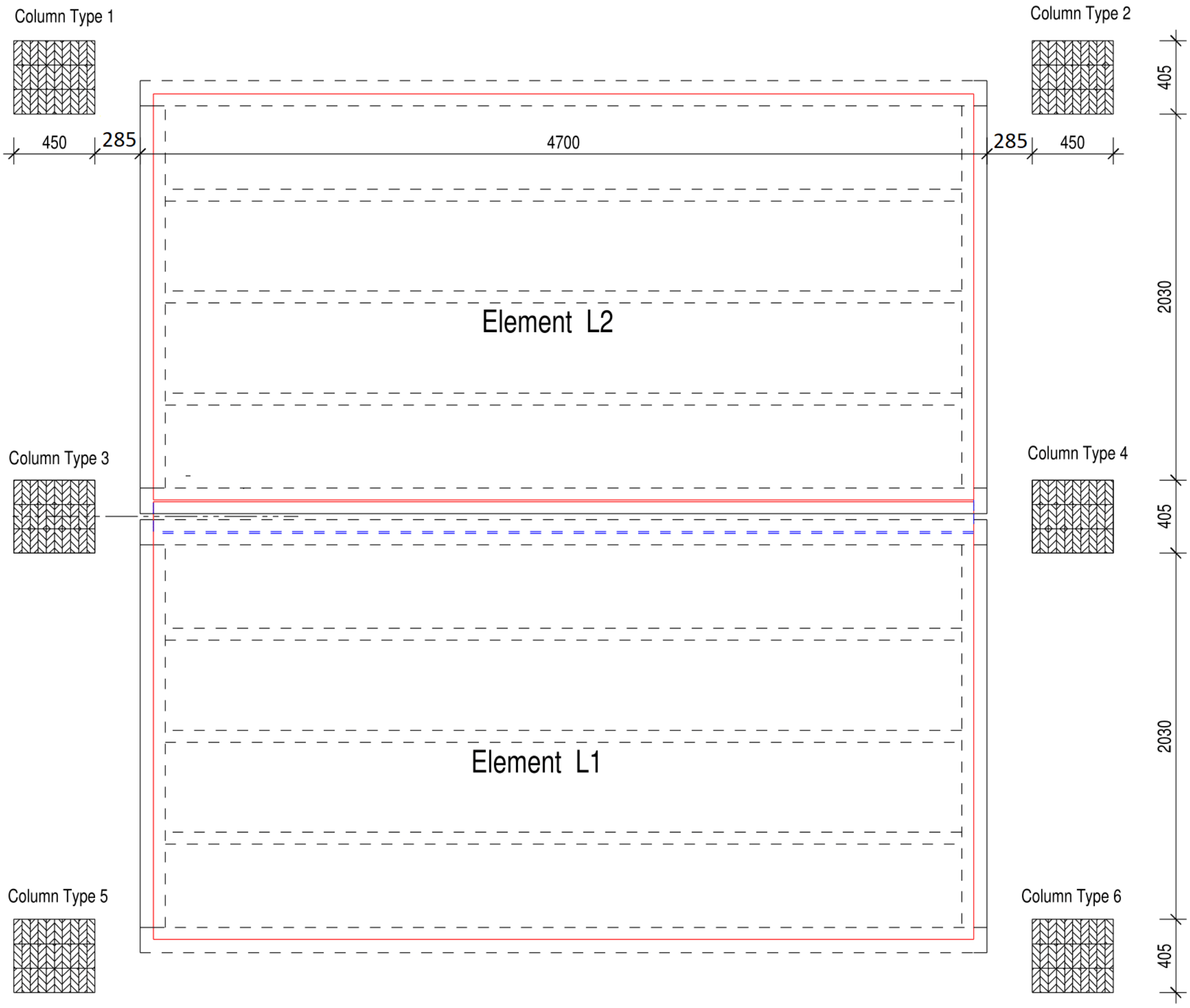


Figure 3.30: Layout for Charlottenlund mock-up, provided through the courtesy of SINTEF Byggforsk

3.5.2 The components of the mock-Up

The following sections present the components used in the mock-up and how they were implemented in a numerical model in SAP2000.

Timber composite-slabs

The floor elements are built according to the findings of Bjørge and Kristoffersen in their thesis from 2017[36]. Bjørge and Kristoffersen performed a conceptual study of timber composite-slabs, aimed to be used in the WoodSol project. The findings suggested a slab composite built up of two components, Kerto-Q plates as the bottom and top flanges and glulam beams as webs, see Figure 3.31. In the prototype, the top and bottom flange had a designed thickness of 45 and 63 mm respectively, but the delivered material had a real thickness of 43 and 61 mm due to leveling of the plates. The glulam beams used at the end of the slab had a material quality of GL30c and a cross-section of 140x405mm, while the middle beams were made from GL28c and a cross-section of 66x405 mm.

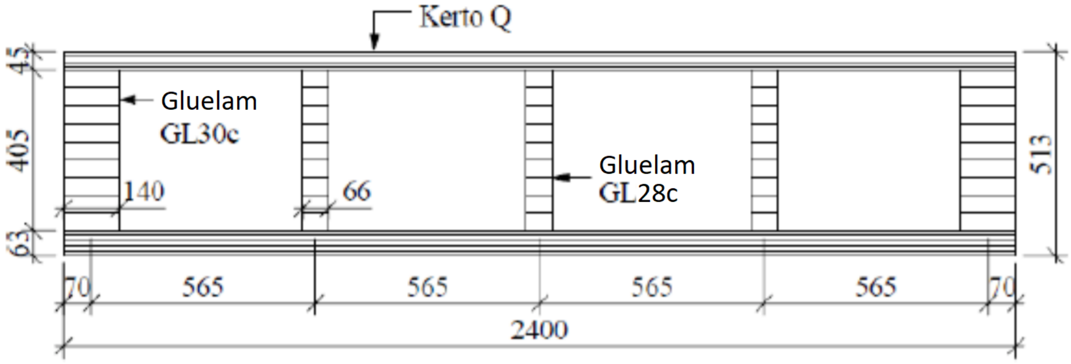


Figure 3.31: Prototype of timber composite slab cross-section, developed by Bjørge and Kristoffersen

In 2018, Sissel Solibakke Mo aimed to create an optimal numerical model for the proposed composite-slab solution, made by Bjørge and Kristoffersen. In her findings, Mo showed that the standardized material properties were to flexible for this specific slab. Through optimization, Mo suggested refined material properties that represent the prototype to a better degree. These material properties are presented in Table 3.20 [37].

	Kerto-Q 43 mm	Kerto-Q 61 mm	GL28C	GL30C
ρ $[kg/m^3]$	~	~	430	430
E_1 $[N/mm^2]$	10500	10500	13300	13830
E_2 $[N/mm^2]$	2350	2900	319	319
E_3 $[N/mm^2]$	130	130	319	319
v_{12}	0,10	0,11	0,39	0,39
v_{13}	0,80	0,81	0,49	0,49
v_{23}	0,70	0,70	0,64	0,64
$G1$ $[N/mm^2]$	600	800	692	692
$G2$ $[N/mm^2]$	120	120	692	692
$G3$ $[N/mm^2]$	22	22	69	69

Table 3.20: Recommended material properties for Kerto-Q 43&61 mm, GL28c and GL30c used in a numerical model

William Espeland, dedicated his thesis to the horizontal stability of tall timber buildings, with WoodSol components as its basis. William made a simplified numerical model of the composite slab created by Bjørge Kristoffersen, due too the long computational time of a full-scale building in 3D [4]. His simplified model used shell elements with equivalent fictitious values, in correspondence to the 3D model presented above. The modeling principals are as follows: Three zones are created as seen in Figure 3.32, which illustrates a simplified cross-section. Zone 1 and Zone 3 illustrates the glulam edge beam at the ends of the composite slab with a width of 140 mm, and Zone 2 represents the rest of the composite slab. All the zones are modeled as homogeneous thick-shell elements, and the material properties used for Zone 1, 2 and 3 are presented in Table 3.21

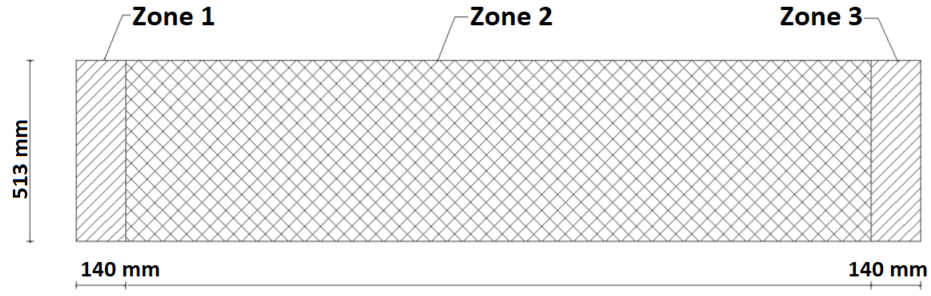


Figure 3.32: A simplified shell model of the 3D slab [4]

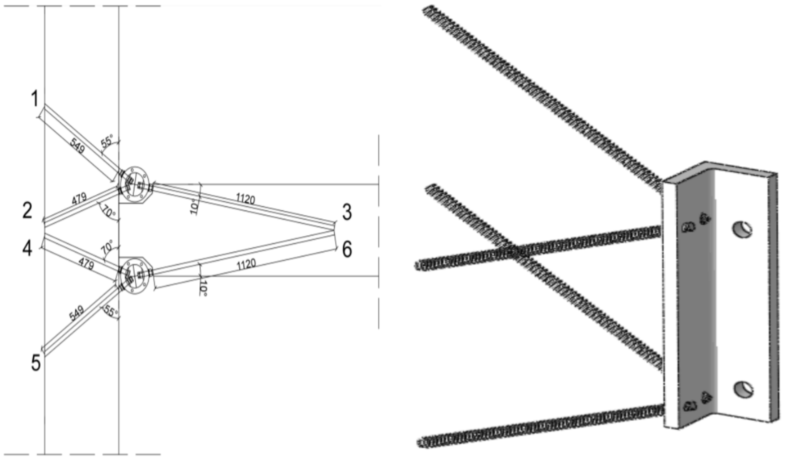
Zone	ρ $[kg/m^3]$	E_1 $[N/mm^2]$	E_2 $[N/mm^2]$	E_3 $[N/mm^2]$	v_{12}	v_{13}	v_{23}	$G1$ $[N/mm^2]$	$G2$ $[N/mm^2]$	$G3$ $[N/mm^2]$
Zone 1 & 3	390	12 000	180	300	0	0	0	100	650	600
Zone 2	390	3930	450	300	0	0	0	85	650	350

Table 3.21: The values for each zone used by William Espeland [4]

Espeland did a small modal- and deformation comparison between his simplified approach and the reference slab. Summarised, the comparison had a deviation of roughly 6 % in the natural frequency for the first three eigenmodes, and 5% in displacements. The simplified model was overly flexible with an evenly distributed load applied, which corresponds with the findings in Mo's thesis.

Slab-to-column connection

The slab-to-column connection was first developed and proposed as a solution in the master thesis of Lied and Nordahl [38]. Lied and Nordahl proposed a circular profile connector with 20 mm threaded rods as fasteners. The connection was further developed by Baartvedt and Pharo, who changed the circular profile connector to a more practical one [39]. Figure 3.33 illustrates Lied and Nordahl's circular connector, and the new connector proposed by Baartvedt and Pharo.



(a) Circular moment resisting connection proposed by Lied and Nordahl

(b) Moment resisting connection proposed by Baartvedt and Pharo

Figure 3.33: Solutions for a moment resisting connection

The numerical results from the new connector had an increase of 23,5% in stiffness compared to the previous one, while also lowering the complexity of the parts required to produce the connection. A desired rotational stiffness of 10 000 kNm/rad - 11 000 kNm/rad was the aim of the connection. This value is based on the work of Malo & Stamatopoulos [40], which states that the required rotational stiffness for a rigid connection in a medium-rise timber building with a height of thirty meters, is between 10 000 - 11 000 kNm/rad. This is to fulfill the serviceability requirement of horizontal displacements $\delta_H \leqslant \frac{Heigth}{300}$. Malo & Stamatopoulos recommends aiming higher as this leaves a safety margin for inaccuracies in production and installment. The circular connection has been tested for various configurations and the results show that the desired rotational stiffness could not be achieved. A more realistic value for the circular connection is around 3800 - 4500 kNm/rad, per plane of rods [40]. The connection developed by Baartvedt and Pharo, has not been experimentally tested. However, it is roughly 23,5% stiffer based on numerical results. Therefore, the experimental values of the circular connection are conservatively used as a rough estimate for the stiffness of the connection, see Figure 3.34

Figure 3.34: Slab-to-column connection

Support conditions

Theoretically, the column supports are only pinned in the y-direction, the same direction as the moment resisting frame. Figure 3.35 shows a close up of the support. The hole for the bolt is pre-drilled with some clearance around the bolt. The support will not resist any rotations until the deformation is large enough for the bolt to collide with the column. Although there is some rotational stiffness about the y- and z-axis, these are treated as pinned as well.

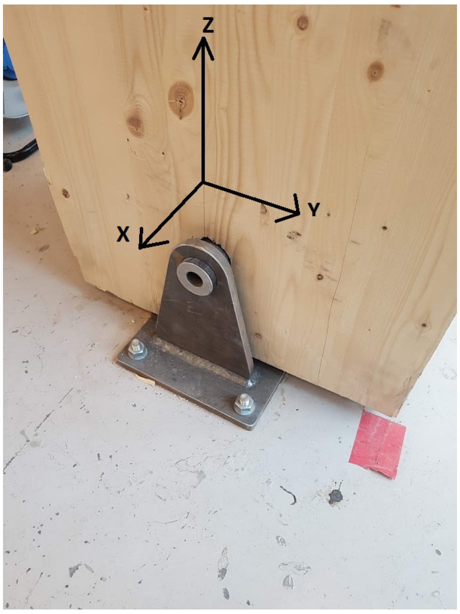


Figure 3.35: Close-up of the support conditions for the column foot

3.5.3 Numerical model of mock-up

A detailed numerical model of the mock-up at Charlottenlund, that can be used to accurately describe the horizontal deformation of the system, requires validated material-and stiffness values for all system components. Inaccuracies in the installment of the components will lead to deviation in regard to theoretical values. The authors of this thesis were not present when the main assembly took place. Thus, without experimentation or validation, the most accurate values for properties and technique's for modeling will be based on the previous works of WoodSol- participants and the preparatory work done in this thesis. Chapter 3 is therefore regarded as the foundation for the modeling. The modeling and simulation are done using SAP2000.

Slabs

The slabs are based on William Espelands simplified modeling approach. A total of two slabs are created, both with identical dimensions and material properties. For each slab, Zone 1 & 3 is modeled with a width of 140 mm and a height of 513 mm ("bending thickness" of the shell element). Zone 2 has the same height as Zone 1 & 3, but has a width of 2435 mm to match the mock-up slabs at Charlottenlund. The length of the slabs is 4700 mm. Figure 3.36 and Figure 3.37 shows the cross-section and a top-down view of each slab respectively. The material properties for the zones are shown in Table 3.22. Properties for Zone 2 is identical to the values in the findings of William Espeland, however Zone 1 & 3 has been modified to match the optimal material properties found by Sissel Sollibaken Mo. For both elements, a thick shell element is used with a membrane thickness of 100mm and a bending thickness of 513 mm.

Figure 3.36: Cross-section of the simplified model for slab elements

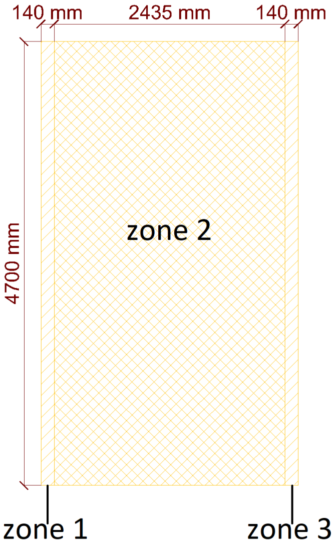


Figure 3.37: Top view of the simplified model of slab elements

Zone	ρ $[kg/m^3]$	E_1 $[N/mm^2]$	E_2 $[N/mm^2]$	E_3 $[N/mm^2]$	v_{12}	v_{13}	v_{23}	$G1$ $[N/mm^2]$	$G2$ $[N/mm^2]$	$G3$ $[N/mm^2]$
Zone 1 & 3	430	13830	319	319	0,39	0,49	0,64	692	692	69
Zone 2	390	3930	450	300	0	0	0	85	650	350

Table 3.22: The material properties used in the numerical model

Figure 3.38 shows the full assembly with 6 thick shell elements connected in SAP2000. The bottom of the slab is at a height of 2000 mm, while the top is at 2500 mm.

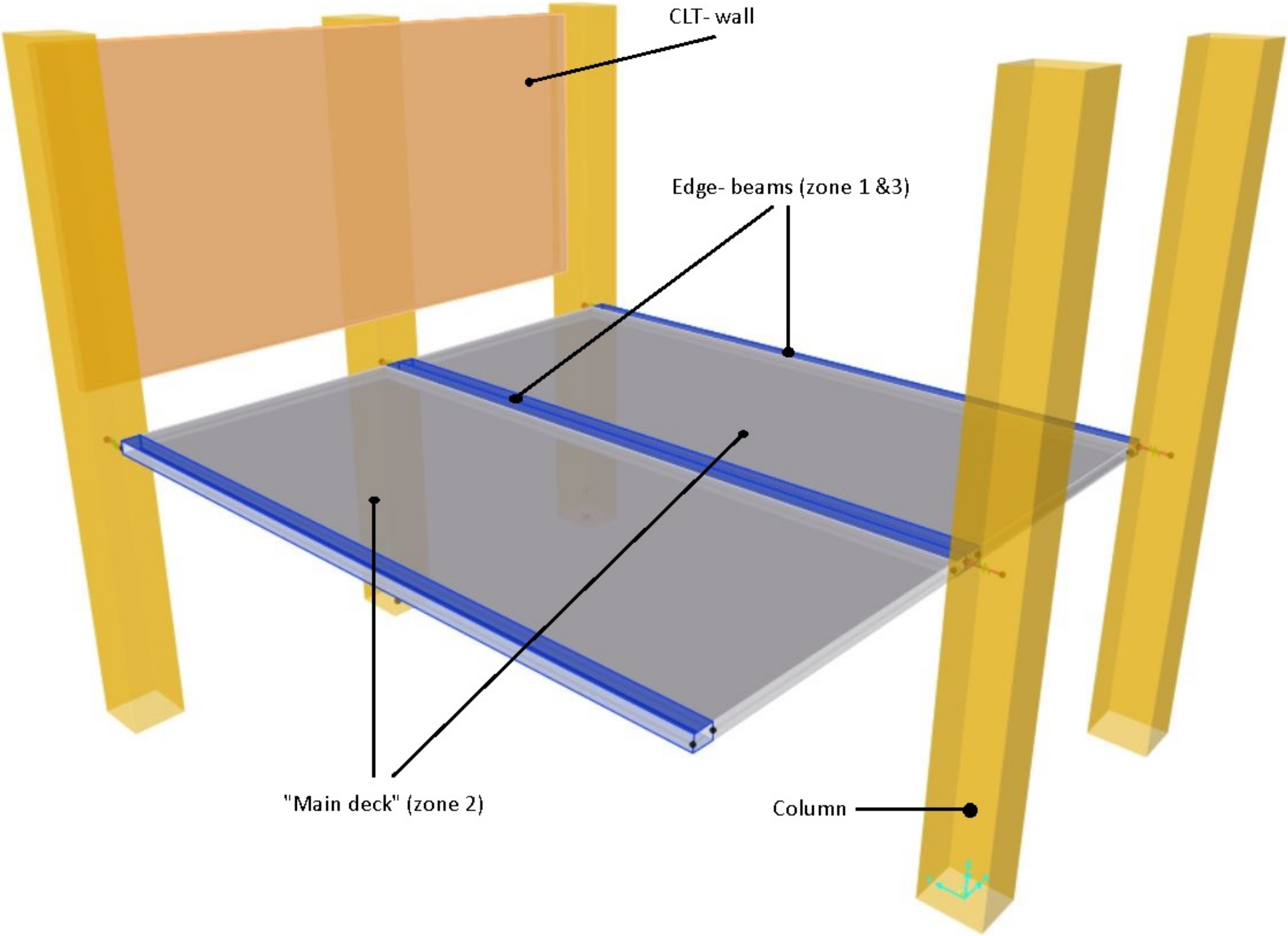


Figure 3.38: Model of mock-up in SAP2000

Slab-to-column connection

The slab-to-column connections are modeled as *linear link objects* with properties assigned to each of the six degrees-of-freedom, three each for translation and rotation. The link objects in SAP2000 connect two joints, i and j, separated by a specified length L, the link properties are illustrated in Figure 3.39. The values used in the model are presented in Table 3.23

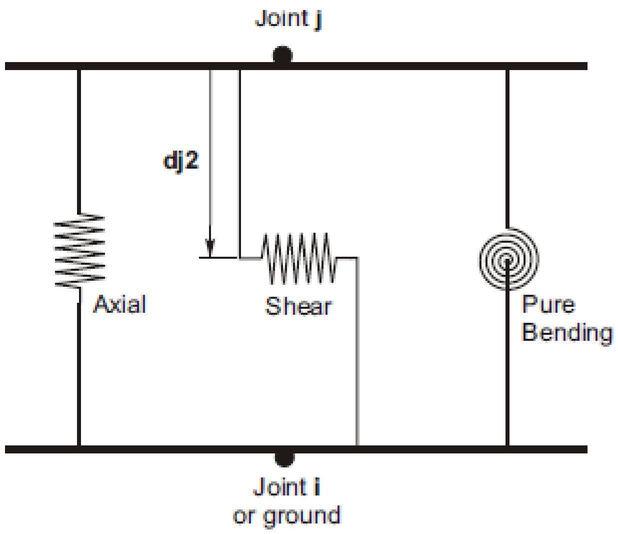


Figure 3.39: Link object definition in SAP2000

The stiffness values presented in Table 3.23 are based on the assumption of 5000 kNm/rad in the "MRF-direction", i.e R3. The rotational stiffness of the connection is modeled as pair of springs, which would describe the rotation in the same way. One spring is then assigned the calculated value in the model. The following equations are then used to calculate the remaining values. See Figure 3.40 for illustration and Appendix B for detailed calculations.

$$U1 = \frac{(\text{ Two sides of bracket}) * (\text{ Two rods}) * R3}{z^2} \qquad (N/mm) \tag{3.18}$$

As a recommendation, based on the uncertainties regarding the combination of axially and transversely loaded rods, the U2 component is set to a tenth of U1.

$$U2 = U1/10 \qquad (N/mm) \tag{3.19}$$

U3 becomes a combination of springs in series. Both are treated as transversely loaded rods and their values are based on Equation 2.7.

$$U3_{slab} = U3_{column} = \frac{(\#\text{ rods}) * (\text{steel-to-timber connection}) * \rho_m^{1.5} * d_{eff}}{23} \qquad (N/mm) \tag{3.20}$$

The total becomes:

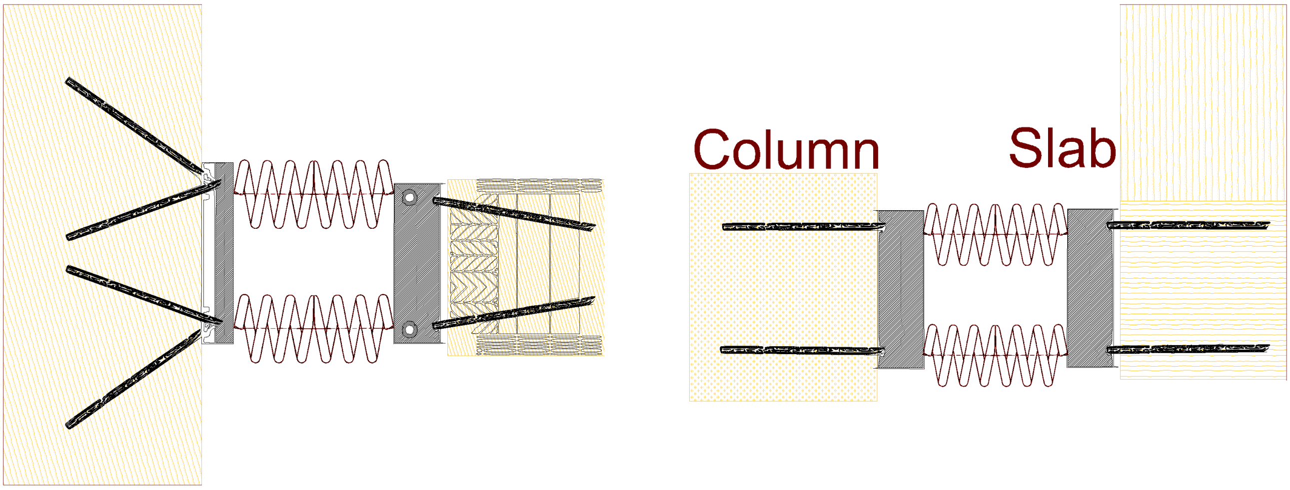
$$U3_{total} = \frac{U3_{slab} * U3_{column}}{U3_{slab} + U3_{column}} \qquad (N/mm) \tag{3.21}$$

As a conservative approach, U3 are set to 70% of $U3_{total}$ due to complexity in the rod behavior.

$$R1 = \frac{U1 * z^2}{4} \qquad (Nmm) \quad \text{and} \quad R2 = \frac{K1}{4}\frac{(z_1^2 + z_2^2)}{2} \qquad (Nmm) \tag{3.22}$$

U1 N/mm	U2 N/mm	U3 N/mm	R1 Nmm	R2 Nmm	R3 Nmm
125000	12500	38000	1.5+E9	9.5E+8	5.0E+9

Table 3.23: Stiffness values for column-slab connection



(a) Side view

(b) Top view

Figure 3.40: Column to slab - connection, modeled as springs

Supports

As discussed, the hole for the bolt is pre-drilled with some tolerance to allow easier installment of the supports. Thus, for small deformations as seen during experimental testing, the wiggle room around the bolt makes it easier and more correct to model it as pinned in all directions.

CLT

The CLT is modeled as a thick shell element, where both the membrane and bending thicknesses are set to 100 mm. The equivalent value method has been used to calculate the material properties for an orthotropic shell and is shown in Table 3.24. The height of the element is 2400 mm and the length is 5275 mm. The bottom of the CLT element is placed 50 mm above the slabs, meaning at an effective height of 2550 mm.

Buildup	$E_{0,eq} = E_1$	$E_{90,eq} = E_2$	$E_y = E_3$	v_{xy}	v_{xz}	v_{yz}	G_{12}	G_{13}	G_{23}
33,3-33,3-33,3	8743	4866	333	0,39	0,49	0,64	633	633	63

Table 3.24: Equivalent values used for the CLT panel in the numerical model

Columns

The columns are modeled as frame objects with sectional dimensions 405x450 mm. The height of the columns are 5038 mm. The material properties used are standardised GL30c values, Table 3.25 shows these values [5][6]. The distances between the columns are obtained from Figure 3.30

Material	E_1	E_2	E_3	v_{12}	v_{13}	v_{23}	G_{12}	G_{13}	G_{23}	Mass Density
GL30C	13000	300	300	0,39	0,49	0,64	650	650	65	430

Table 3.25: Material properties used for GL30C

Fasteners - screws

All fasteners are modeled as *linear link elements*. Each pair of screws are modeled as one fastener, with the same inclination, 30 deg and with the same positions proposed in the layout. This gives two straight lines of fasteners in the columns, with spacings as presented in Section 3.4.2. U1 represents the axial stiffness of the screw, while U2 and U3 describe the transverse stiffness.

U1 N/mm	U2 N/mm	U3 N/mm	R1 Nmm	R2 Nmm	R3 Nmm
16800	8520	8520	2.0E+6	2.0E+6	2.0E+6

Table 3.26: Stiffness values for fasteners

Chapter 4

Experimental work

4.1 Introduction

To fully understand a structure's behavior, numerical models often fall shorthanded to provide a full representation of the true deformation patterns. The high complexity of a structure results in a high degree of uncertainty, leading to a conservative approach when making design decisions. There are often mechanisms in the structure that are hard to anticipate numerically, which makes experiments valuable and a good opportunity to verify computer simulations. In this thesis, the tests on the mock-up at Charlottenlund are used to describe the effectiveness of a CLT panel fastened to the outside of columns, but also as a tool to verify the numerical model described in Chapter 3.

The tests at Charlottenlund took place in late April 2019. As the purpose of the tests were to observe the stiffness contribution from a CLT wall on a system, the testing was split into two main phases. In phase one, a number of loading-unloading cycles were done on the mock-up without the CLT panel installed, see Figure 4.1a. The second phase consisted of extensive testing done with the CLT panel mounted to the mock- up, Figure 4.1b. The tests performed in Phase 2 were undergone with 9 different screw configurations. This was done to develop an understanding of how the stiffness was affected by the number of screws and their positioning. The configurations used are illustrated in Figure 3.28.

(a) Mock-up without CLT panel

(b) Mock-up with CLT panel

Figure 4.1: Mock-up

4.1.1 Preparatory work

Prior to the assembly and testing of the CLT panel, a lot of coordination and decision making was done to assure that the test procedures would lead up to the most useful results. The factors that had the greatest influence on the test procedure and on the end results are described in the following sections. With regard to the weight and dimensions of the CLT panel, the assembly process is divided into several stages. The following subsections are described and presented in the order as the work was undergone in the lab.

Panel adjustment and layout design

The wall was brought inside, marked and then cut to fit the exact geometry of the span of the columns. As the wall was ordered with exact height, no height adjustment was needed. The outline of the columns and the layout for the screws were measured and marked on the wall with pencils. No moisture measurements were conducted prior to, or during testing.

Figure 4.2: Adjustment and marking of the CLT panel

Fastening of screws

To safeguard and obtain the desired inclination of the screws, inclination brackets were created with help from the staff at the laboratories at NTNU. With an angle of approximately 30 degrees, the brackets would assist and guide the screw into the CLT panel within acceptable limits.

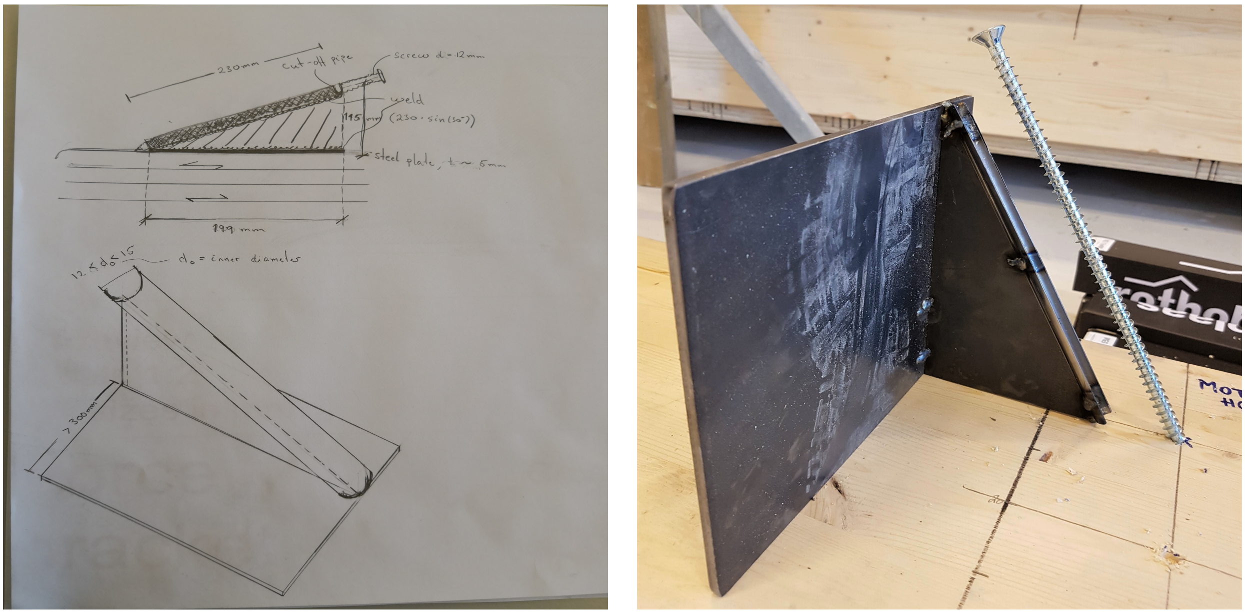


Figure 4.3: From sketch to production

Having in mind the considerable dimensions of the screws and the effort it takes to insert them at an angle to the grain, insertion holes for the tip of the screw were pre-drilled by a few centimeters. This would also help to prevent slipping as pressure is applied to the screw during the installation process. This made the next step of drilling the screws into the CLT much easier. With the wall lying flat on underlying pallets, these steps were repeated for every entry-point of the screws. Every fastener was then drilled into the CLT with a little clearance to avoid piercing through the thickness of the wall. Simple Milwaukee cordless drills were used during the insertion process. The final result is seen in Figure 4.4.

Figure 4.4: Pre-drilling and fastening of screws

Positioning and fastening of CLT panel to columns

The panel was then positioned, tilted and raised to the designated height on the columns. By the use of levelers and mounting brackets, the panel was installed by temporary screws to hold it in position. The installation process is shown in the pictures of Figure 4.5.

Figure 4.5: Installation of CLT to columns

Load measuring and application

To ensure that the CLT panel was fully utilized during loading, it was decided to apply the load above the panel, in the first column. To minimize the eccentricity, with respect to the neutral axis of the panel, a 10 mm thick steel plate was designed and mounted on the outer side of the column, see Figure 4.6.

As the objective was to observe and measure the horizontal displacement of the structure, a 3 ton capacity chain puller was used to create the external loading. Fastened to the column with steel struts, the puller was then hinged to a steel bracket, which was anchored in the concrete floor using anchors and threaded rods, Figure 4.7b.

The path between the steel plate on top of the column and the anchoring point was designed to create 45 degrees to the horizontal plane, i.e the floor. This would make decomposition of the force rather easy. A load cell with a capacity of measuring 50 kN of force was mounted on the path between the two endpoints.

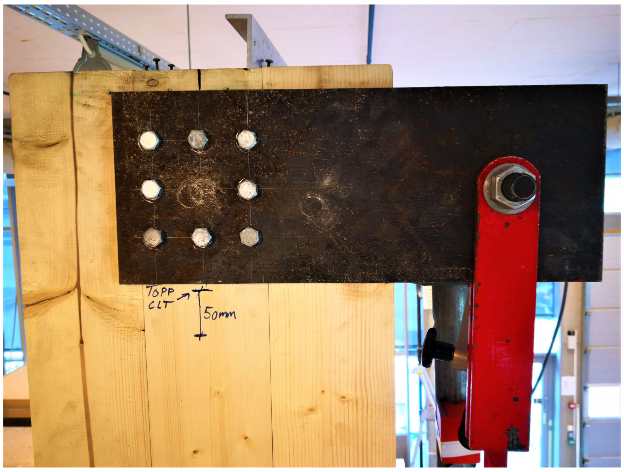
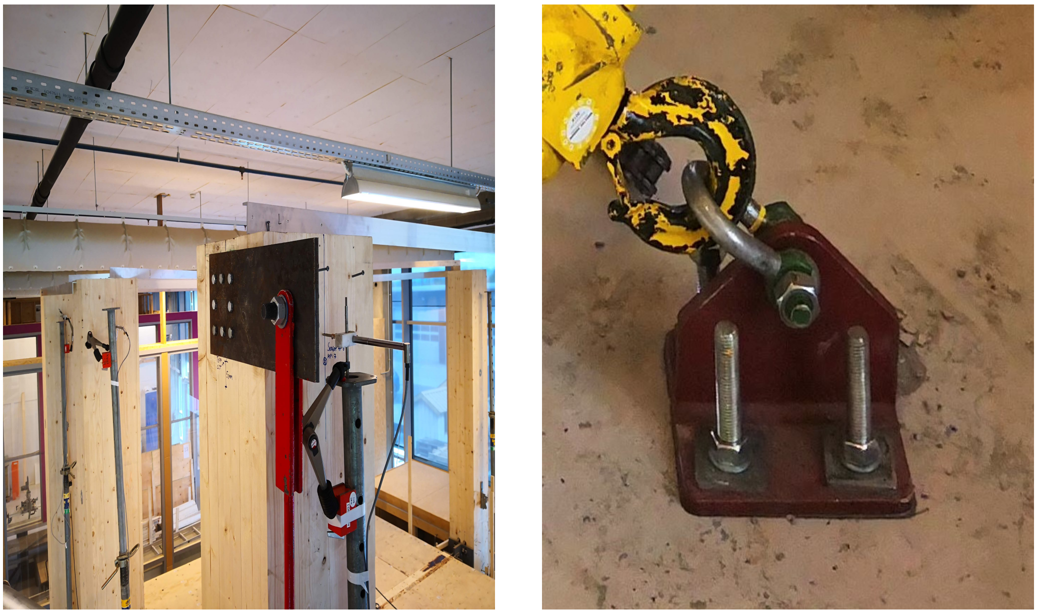


Figure 4.6: Detailed view of loaded steel plate



(a) Steel plate to column

(b) Anchoring point

Figure 4.7: End points

4.1.2 Test setup and configurations

To measure the effect of the loading, 10 measuring points were installed on the mock-up using LVDT- sensors (Linear Variable Differential Transformer). Sensor IDs and validity ranges are shown in Table 4.1, in-depth sensor descriptions are presented in Appendix C.

Sensor ID	1	2	3	4	5	6	7	8	9	10
Validity range [mm]	±2	0-50	0-50	±2	0-50	0-50	±2	±2	±2	0-50

Table 4.1: Sensor IDs

LVDT is a high precision electromechanical transducer that monitors the behavior, i.e horizontal displacement in this case, of the mock-up during the loading cycles. All sensors were installed on retractable mono-pods with adjustable lever arms. After all sensor positions were fine-tuned perpendicular to the front of the columns, they were leveled parallel to the floor and locked in position, see Figure 4.8.

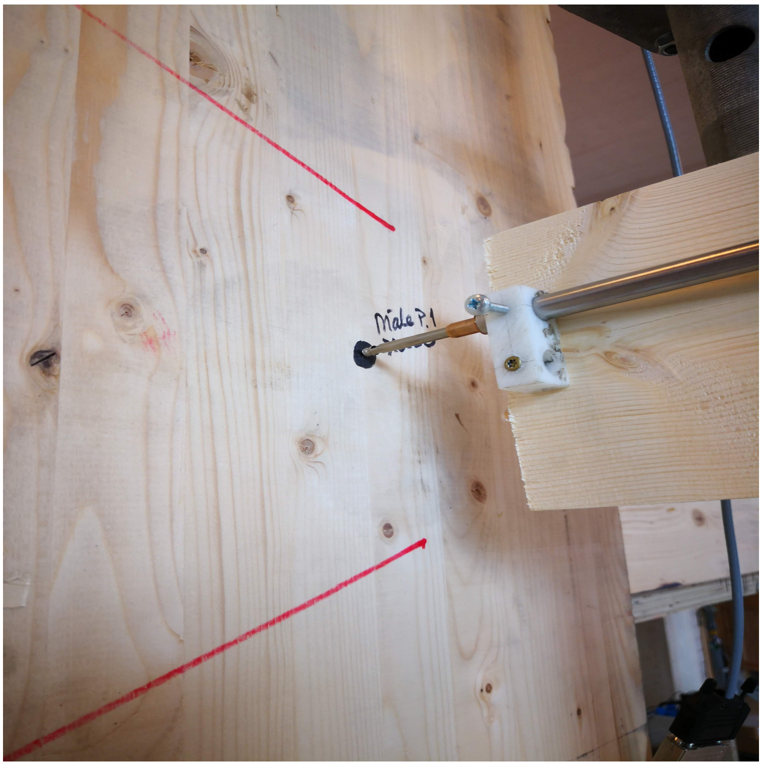


Figure 4.8: Correct transducer position

The arrangement of the gauge points and their positions are depicted in Figure 4.9 - 4.11.

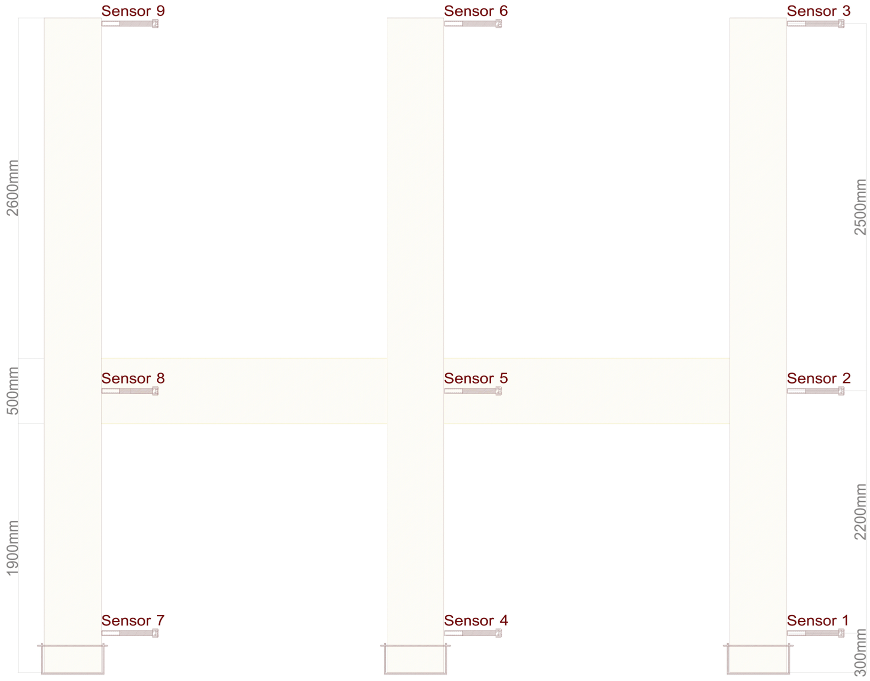


Figure 4.9: Sensor position, side view

Figure 4.10: Sensor position, top view

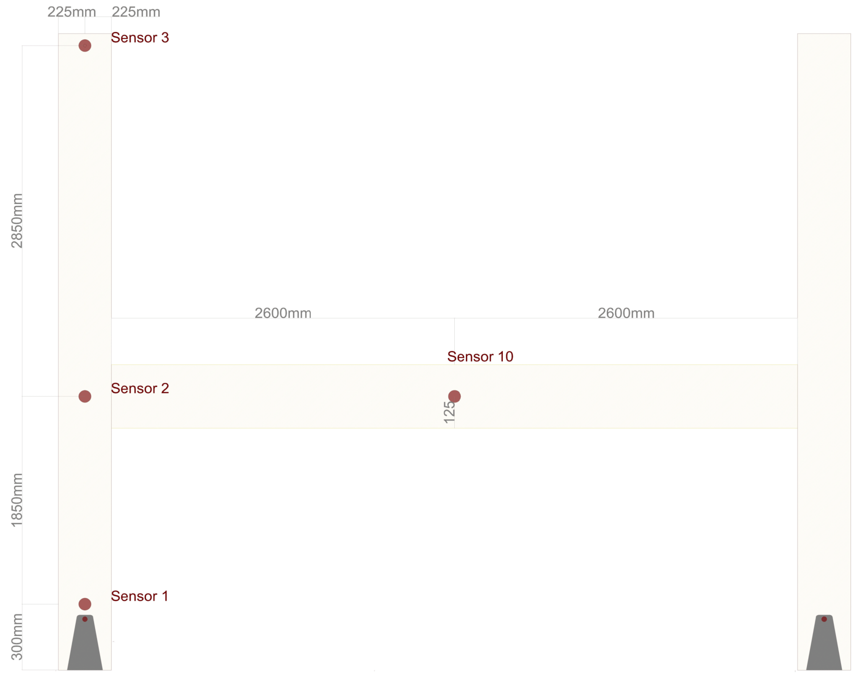
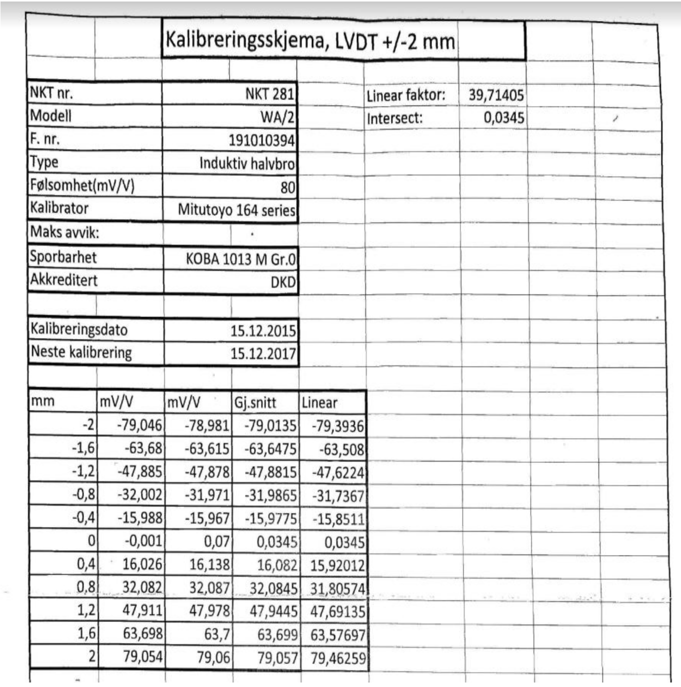


Figure 4.11: Sensor position, front view

All sensors, i.e LVDT- sensors and the load cell, were connected through a measurement/amplifier module into a laptop. The PC logged both applied load and displacement of all sensors during the tests in a software named catman. To make sure all sensors measured within their validity range, each one was calibrated with its own calibration scheme during the setup. A scheme for sensor 4 is presented in Figure 4.12.



Kalibreringsskjema, LVDT +/-2 mm

NKT nr.	NKT 281	Linear faktor:	39,71405
Modell	WA/2	Intersect:	0,0345
F. nr.	191010394		
Type	Induktiv halvbro		
Følsomhet(mV/V)	80		
Kalibrator	Mitutoyo 164 series		
Maks avvik:	-		
Sporbarhet	KOBA 1013 M Gr.0		
Akkreditert	DKD		

Kalibreringsdato	15.12.2015
Neste kalibrering	15.12.2017

mm	mV/V	mV/V	Gj.snitt	Linear
-2	-79,046	-78,981	-79,0135	-79,3936
-1,6	-63,68	-63,615	-63,6475	-63,508
-1,2	-47,885	-47,878	-47,8815	-47,6224
-0,8	-32,002	-31,971	-31,9865	-31,7367
-0,4	-15,988	-15,967	-15,9775	-15,8511
0	-0,001	0,07	0,0345	0,0345
0,4	16,026	16,138	16,082	15,92012
0,8	32,082	32,087	32,0845	31,80574
1,2	47,911	47,978	47,9445	47,69135
1,6	63,698	63,7	63,699	63,57697
2	79,054	79,06	79,057	79,46259

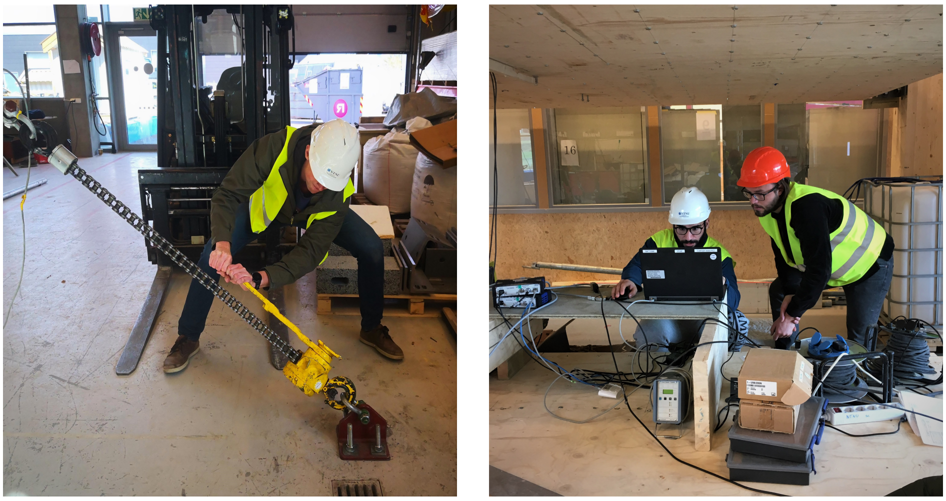
Figure 4.12: Calibration scheme for sensor 4

4.1.3 Test procedure

All of the tests were executed as cycles of loading and unloading, with a total of eight repetitive cycles. Three series were performed for each configuration of screws. Prior to all series, the position of the transducers was carefully adjusted to ensure sufficient contact with the column as well as being perpendicular to the surface. The equipment along the load path was prestressed with a little force from the pulley to prevent slip between the connecting members. When adjusted, the load cell, Figure 4.14, was reset and all the transducers were zero-balanced at their current position. The described steps were used prior to each series performed.

Phase 1 - testing without panel

Phase 1 of the testing was completed with only minor issues. Due to high displacement in some of the sensors, the load had to be decreased to 6 kN, as a total force, to keep them within their limits. As the pulley was operated manually, some practice runs were conducted to ensure all cycles were performed within the same amount of time and as steadily possible. An average of 15-20 seconds was used during a single loading/offloading cycle, anything slower than that resulted in a "laggy" behavior from the pulley and unevenly measuring results.



(a) Operating the pulley (b) Monitoring load cell and transducers

Figure 4.13: Test procedure

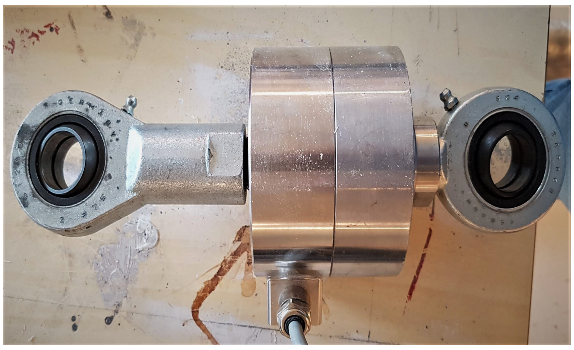


Figure 4.14: Load cell

Phase 2 - testing with CLT panel

Prior to testing of the CLT panel, the front column had to be adjusted due to the rotation it had obtained from the previous loading cycles. A forklift was used to push the column back, while some screws were installed temporarily to ensure that the column and CLT panel were aligned, illustrated in Figure 4.15.

(a) Slightly misaligned column after Configuration 0

(b) Leveling

(c) Column aligned with CLT panel

Figure 4.15: Aligning

The remaining screws from the first configuration were then installed in the column as described in the layout from Section 3.4.2. A powerful drill with high torque capacity was used to insert the screws into the columns, as seen in Figure 4.17. Temporary screws and brackets were removed, leaving the wall with 10 of the outermost screws in top and bottom installed in each column.

The configurations are listed in Table 4.2.

Configuration	**Inserted groups**
1	A1
2	A1+A2
3	A1+A2+A3
4	A1+A2+A3+A4
5	A1+A2+A3+A4+A5
6	A2+A3+A4+A5
7	A3+A4+A5
8	A4+A5
9	A5

Table 4.2: Configurations organized in groups, see Figure 3.28

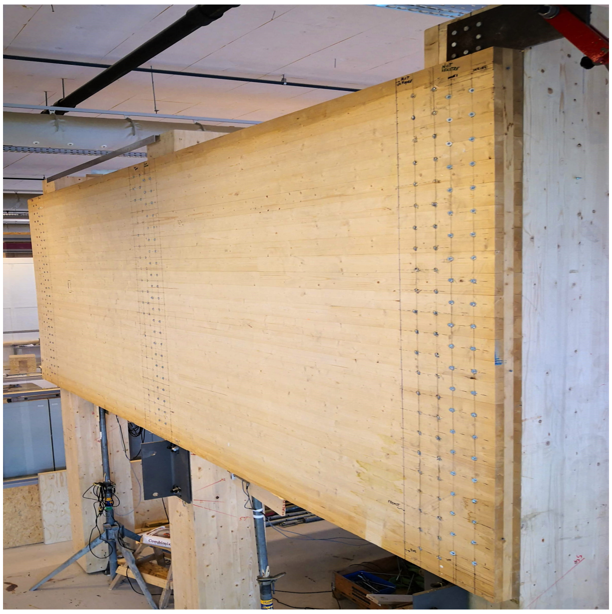
(a) Powerful tools require strong men to be tamed

(b) Configuration 1 installed

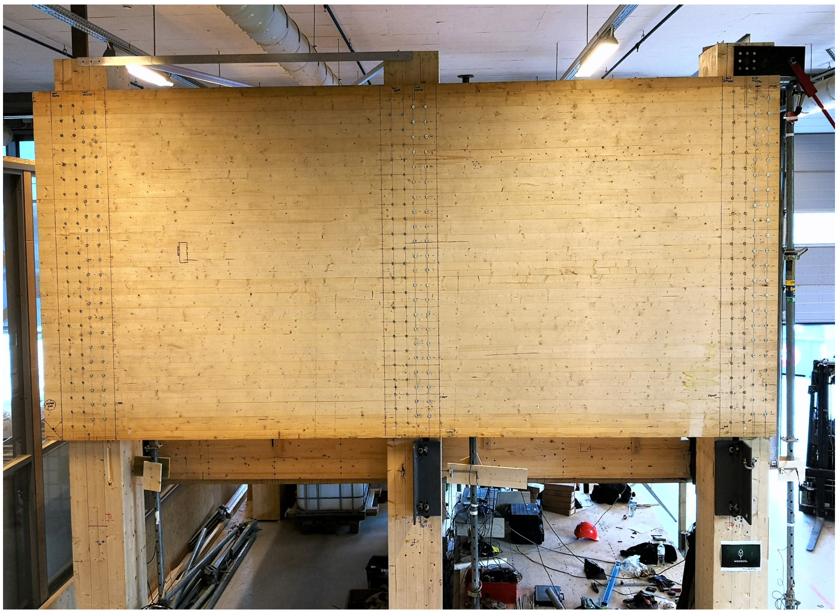
Figure 4.16: Installation of screws

When measuring and collecting data during testing, 10 and later on 50 data points were logged each second in catman to provide sufficient data for analysis. After one test, the puller was whined down giving the system some slack so it could return to its natural position. Sensors were then rechecked and the system was ready for the next series of cycles.

All steps were performed identically for every configuration of screws until all screws, 270 in total, were installed, i.e Configuration 5. The final results of the installment can be seen in Figure 4.17.



(a) Configuration 5, side view



(b) Configuration 5, front view

Figure 4.17: All screws installed

The process, of installing screws, was reversed when tests with Configuration 6-9 were carried out. With only 10 screws installed at the midpoint of each column and CLT panel, Configuration 9 was the last one tested. It became noticeable that the placement of screws was the least favorable for the system, as expected prior to testing. Large deformations in the loaded column was registered in catman as well as visual confirmation throughout the series of testing. The effect of misalignment can be seen in Figure 4.18.

Figure 4.18: Slip between CLT- wall and column after tests on Configuration 9

Chapter 5

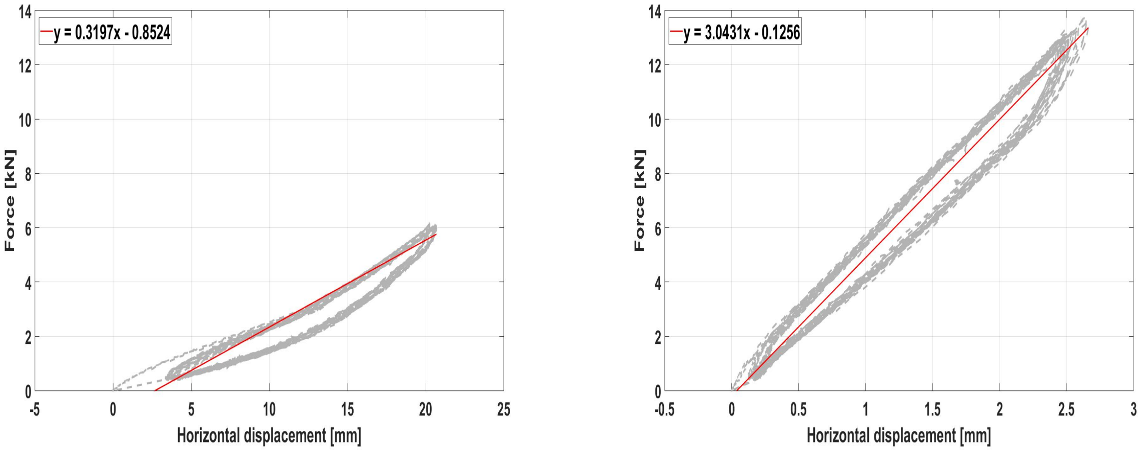
Results

This chapter presents the results from both the experimental tests and the numerical model. Data from the experiment are presented in two parts, *force-deflection* and *dynamic* results. Due to the vast amount of data that was collected during testing, only the most representative and significant values are presented in this chapter. Detailed and full information of all sensor-data, configurations and cycles are presented in Appendix D. The numerical results are presented as pre- and post-calibrated. The experimental values of forces and displacements are used as reference values to calibrate the numerical model.

5.1 Experimental results

5.1.1 Force- displacement

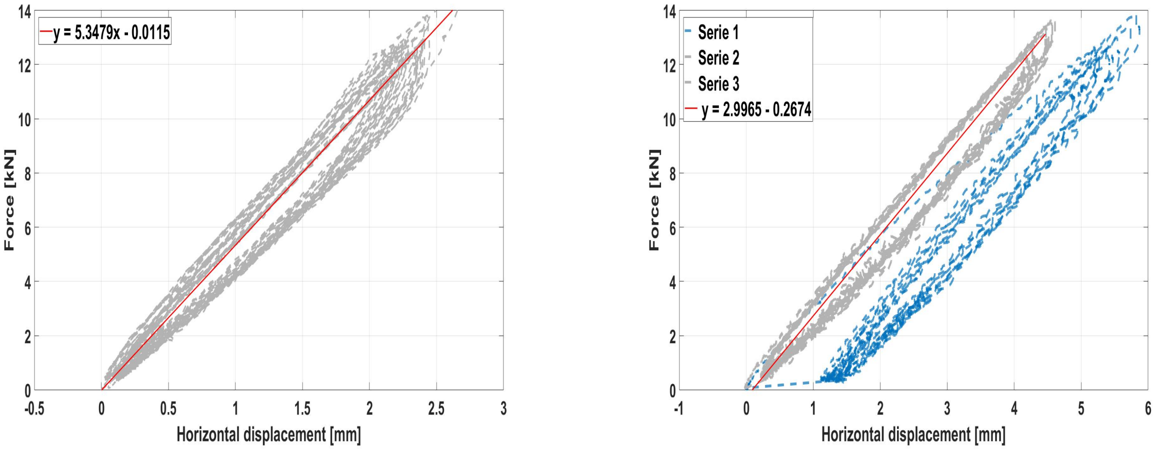
As explained earlier, a total of 10 configurations were tested during the experiment, if the mock-up without the CLT element is included. Each configuration was divided into three series with a total of 8 loading and unloading cycles. The force-displacement relationship for sensor 2, from Configuration 0 and 2, is represented through hysteresis loops as seen in Figure 5.16b - Figure 5.16a. All of the sensors are represented similar to these plots, for every series performed. A regression line, depicted red, is calculated for each cycle (one loading and unloading), resulting in a total of 8 regression lines for each series. The regression line represents the stiffness at the sensor position and the compliance, i.e the flexibility, is obtained as the inverse of this value.



(a) Configuration 0, sensor 2

(b) Configuration 2, sensor 2

Figure 5.1: Force-displacement hysteresis

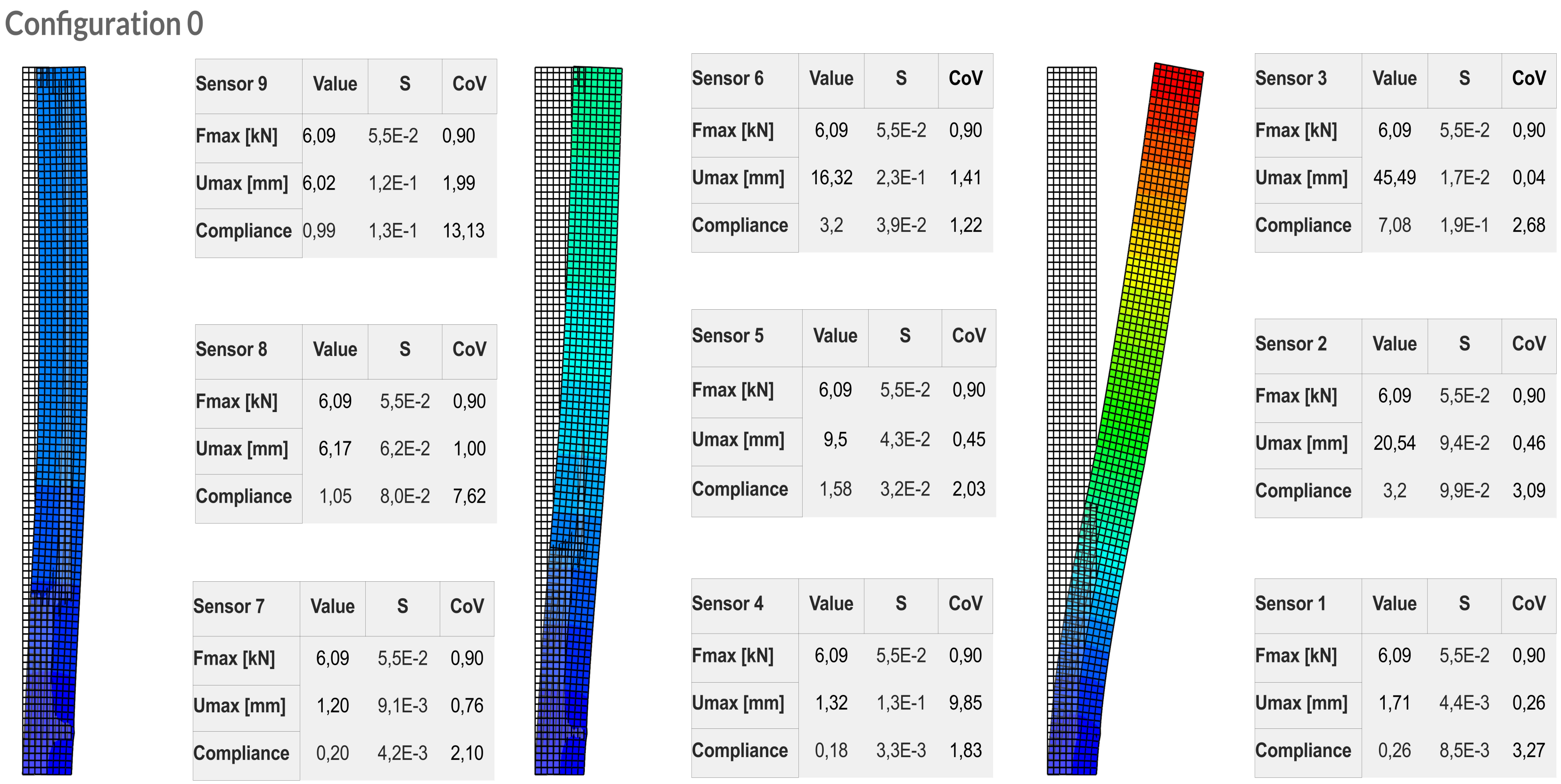


(a) Configuration 5, sensor 2

(b) Configuration 8, sensor 2

Figure 5.2: Force-displacement hysteresis

Figure 5.3 to Figure 5.12 shows the average values for the maximum force applied, maximum horizontal deformation obtained and the inverse of the stiffness i.e. the compliance, for each sensor in each configuration. S and CoV shows the standard deviation and the coefficient of variation for each of the averaged results. The standard deviation is presented in millimeters while the coefficient of variation is in percentage %. The 2D figures are scaled in relation to each other to better visualize the deformed shape of each column. The panel is not drawn in the figures, as the displacement values obtained are from the columns.



Configuration 0

Sensor 9	Value	S	CoV
Fmax [kN]	6,09	5,5E-2	0,90
Umax [mm]	6,02	1,2E-1	1,99
Compliance	0,99	1,3E-1	13,13

Sensor 8	Value	S	CoV
Fmax [kN]	6,09	5,5E-2	0,90
Umax [mm]	6,17	6,2E-2	1,00
Compliance	1,05	8,0E-2	7,62

Sensor 7	Value	S	CoV
Fmax [kN]	6,09	5,5E-2	0,90
Umax [mm]	1,20	9,1E-3	0,76
Compliance	0,20	4,2E-3	2,10

Sensor 6	Value	S	CoV
Fmax [kN]	6,09	5,5E-2	0,90
Umax [mm]	16,32	2,3E-1	1,41
Compliance	3,2	3,9E-2	1,22

Sensor 5	Value	S	CoV
Fmax [kN]	6,09	5,5E-2	0,90
Umax [mm]	9,5	4,3E-2	0,45
Compliance	1,58	3,2E-2	2,03

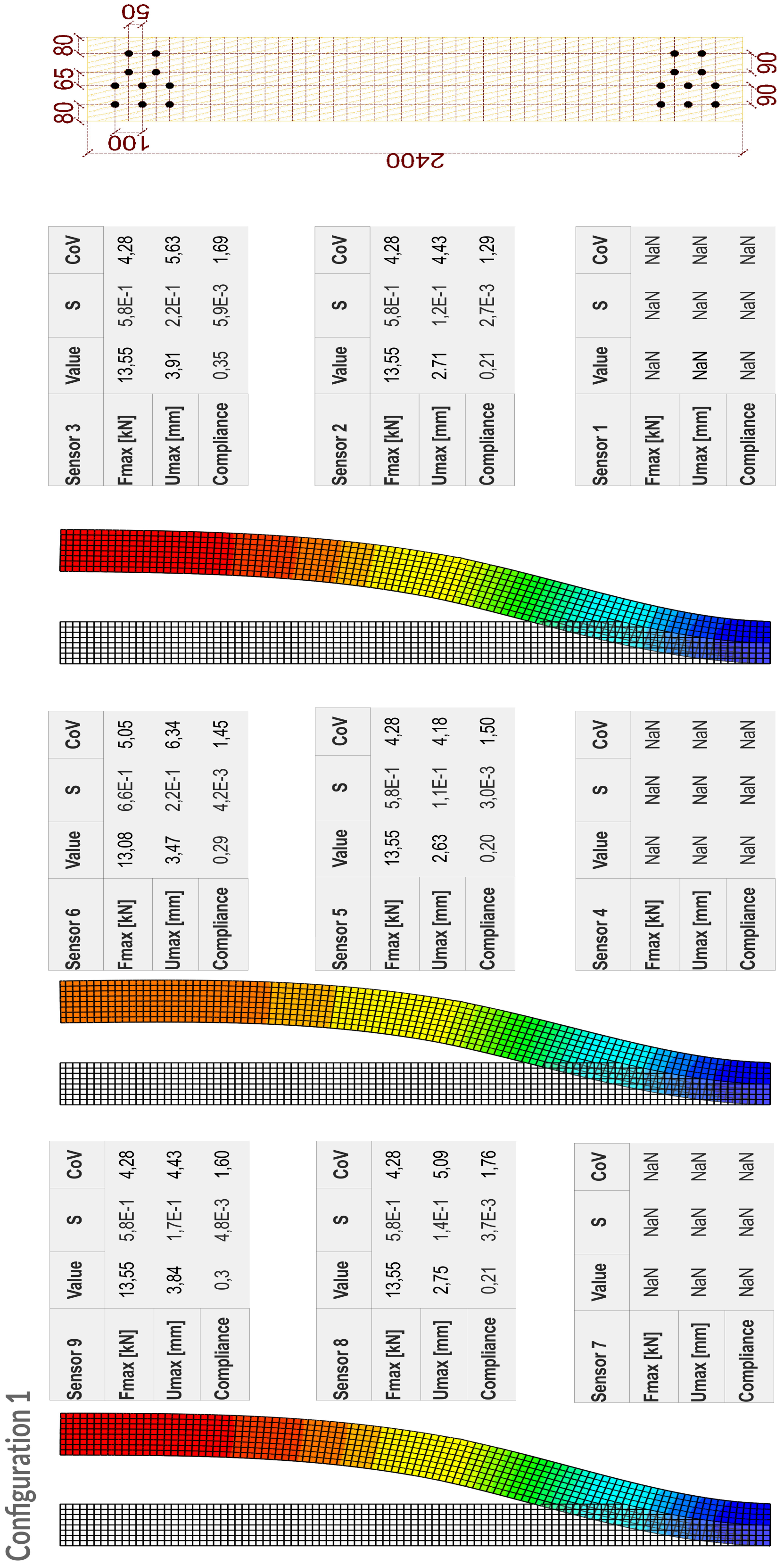
Sensor 4	Value	S	CoV
Fmax [kN]	6,09	5,5E-2	0,90
Umax [mm]	1,32	1,3E-1	9,85
Compliance	0,18	3,3E-3	1,83

Sensor 3	Value	S	CoV
Fmax [kN]	6,09	5,5E-2	0,90
Umax [mm]	45,49	1,7E-2	0,04
Compliance	7,08	1,9E-1	2,68

Sensor 2	Value	S	CoV
Fmax [kN]	6,09	5,5E-2	0,90
Umax [mm]	20,54	9,4E-2	0,46
Compliance	3,2	9,9E-2	3,09

Sensor 1	Value	S	CoV
Fmax [kN]	6,09	5,5E-2	0,90
Umax [mm]	1,71	4,4E-3	0,26
Compliance	0,26	8,5E-3	3,27

Figure 5.3: Configuration 0, main results



Sensor 9	Value	S	CoV
Fmax [kN]	13,55	5,8E-1	4,28
Umax [mm]	3,84	1,7E-1	4,43
Compliance	0,3	4,8E-3	1,60

Sensor 8	Value	S	CoV
Fmax [kN]	13,55	5,8E-1	4,28
Umax [mm]	2,75	1,4E-1	5,09
Compliance	0,21	3,7E-3	1,76

Sensor 7	Value	S	CoV
Fmax [kN]	NaN	NaN	NaN
Umax [mm]	NaN	NaN	NaN
Compliance	NaN	NaN	NaN

Sensor 6	Value	S	CoV
Fmax [kN]	13,08	6,6E-1	5,05
Umax [mm]	3,47	2,2E-1	6,34
Compliance	0,29	4,2E-3	1,45

Sensor 5	Value	S	CoV
Fmax [kN]	13,55	5,8E-1	4,28
Umax [mm]	2,63	1,1E-1	4,18
Compliance	0,20	3,0E-3	1,50

Sensor 4	Value	S	CoV
Fmax [kN]	NaN	NaN	NaN
Umax [mm]	NaN	NaN	NaN
Compliance	NaN	NaN	NaN

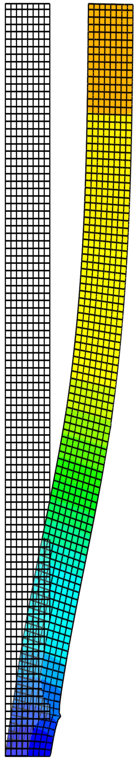
Sensor 3	Value	S	CoV
Fmax [kN]	13,55	5,8E-1	4,28
Umax [mm]	3,91	2,2E-1	5,63
Compliance	0,35	5,9E-3	1,69

Sensor 2	Value	S	CoV
Fmax [kN]	13,55	5,8E-1	4,28
Umax [mm]	2,71	1,2E-1	4,43
Compliance	0,21	2,7E-3	1,29

Sensor 1	Value	S	CoV
Fmax [kN]	NaN	NaN	NaN
Umax [mm]	NaN	NaN	NaN
Compliance	NaN	NaN	NaN

Figure 5.4: Configuration 1, main results

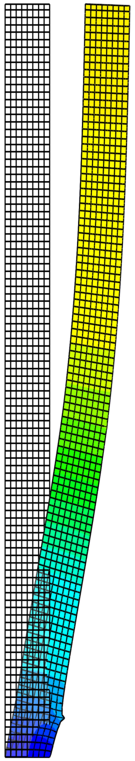
Configuration 2



Sensor 9	Value	S	CoV
Fmax [kN]	13,06	1,2E-1	0,92
Umax [mm]	3,39	3,6E-2	1,06
Compliance	0,26	1,4E-3	0,54

Sensor 8	Value	S	CoV
Fmax [kN]	13,06	1,2E-1	0,92
Umax [mm]	2,48	2,3E-2	0,93
Compliance	0,19	9,0E-4	0,47

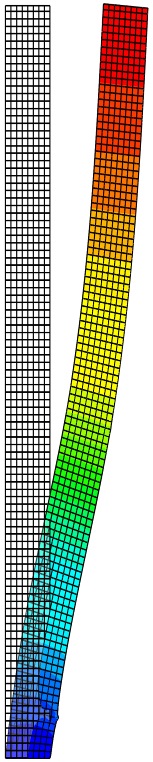
Sensor 7	Value	S	CoV
Fmax [kN]	13,06	1,2E-1	0,92
Umax [mm]	0,44	3,8E-3	0,86
Compliance	0,034	0,0E-0	0,00



Sensor 6	Value	S	CoV
Fmax [kN]	13,06	1,2E-1	0,92
Umax [mm]	3,3	1,5E-1	4,55
Compliance	0,25	3,8E-3	1,52

Sensor 5	Value	S	CoV
Fmax [kN]	13,06	1,2E-1	0,92
Umax [mm]	2,35	2,2E-2	0,94
Compliance	0,184	1,3E-3	0,71

Sensor 4	Value	S	CoV
Fmax [kN]	13,06	1,2E-1	0,92
Umax [mm]	0,61	6,3E-3	1,03
Compliance	0,097	2,2E-3	0,27



Sensor 3	Value	S	CoV
Fmax [kN]	13,06	1,2E-1	0,92
Umax [mm]	4,00	9,2E-2	2,30
Compliance	0,33	3,0E-3	0,91

Sensor 2	Value	S	CoV
Fmax [kN]	13,06	1,2E-1	0,92
Umax [mm]	2,49	2,4E-2	0,96
Compliance	0,20	1,4E-3	0,70

Sensor 1	Value	S	CoV
Fmax [kN]	13,06	1,2E-1	0,92
Umax [mm]	0,35	3,3E-3	0,94
Compliance	0,0274	5,0E-4	1,82

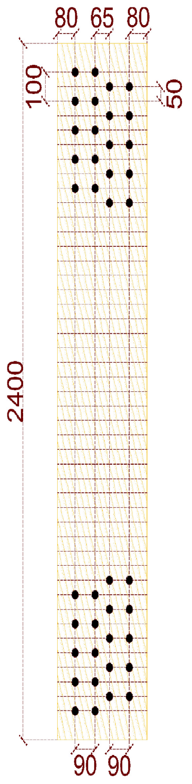
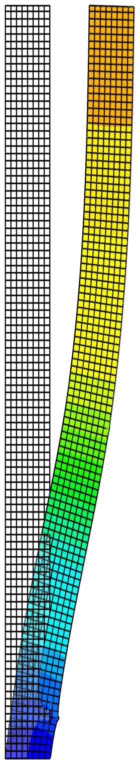


Figure 5.5: Configuration 2, main results

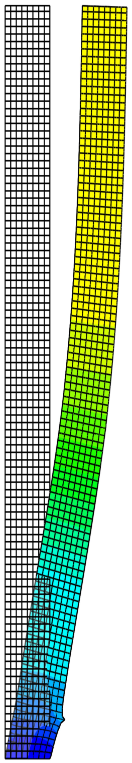
Configuration 3



Sensor 9	Value	S	CoV
Fmax [kN]	13,21	3,5E-1	2,65
Umax [mm]	3,45	6,1E-2	1,77
Compliance	0,258	2,8E-3	1,09

Sensor 8	Value	S	CoV
Fmax [kN]	13,21	3,5E-1	2,65
Umax [mm]	2,44	6,4E-2	2,62
Compliance	0,188	1,8E-3	0,96

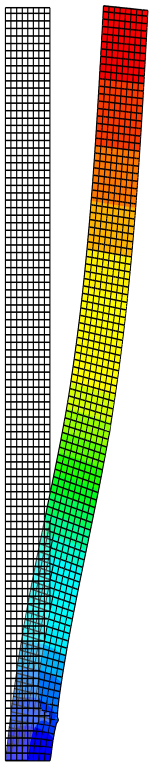
Sensor 7	Value	S	CoV
Fmax [kN]	13,21	3,5E-1	2,65
Umax [mm]	0,37	1,1E-2	2,97
Compliance	0,029	5,0E-4	1,72



Sensor 6	Value	S	CoV
Fmax [kN]	13,21	3,5E-1	2,65
Umax [mm]	3,17	1,4E-1	4,42
Compliance	0,249	3,8E-3	1,53

Sensor 5	Value	S	CoV
Fmax [kN]	13,21	3,5E-1	2,65
Umax [mm]	2,30	6,0E-2	2,61
Compliance	0,181	1,8E-3	0,99

Sensor 4	Value	S	CoV
Fmax [kN]	13,21	3,5E-1	2,65
Umax [mm]	0,61	1,9E-2	3,12
Compliance	0,047	7,6E-4	1,62



Sensor 3	Value	S	CoV
Fmax [kN]	13,21	3,5E-1	2,65
Umax [mm]	4,03	1,5E-1	3,72
Compliance	0,32	4,7E-3	1,47

Sensor 2	Value	S	CoV
Fmax [kN]	13,21	3,5E-1	2,65
Umax [mm]	2,47	7,2E-2	2,92
Compliance	0,195	2,2E-3	1,13

Sensor 1	Value	S	CoV
Fmax [kN]	13,21	3,5E-1	2,65
Umax [mm]	0,35	9,3E-3	2,66
Compliance	0,0277	4,5E-4	1,63

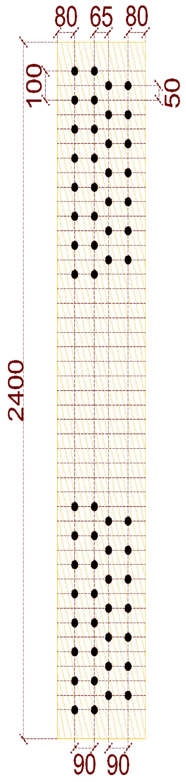
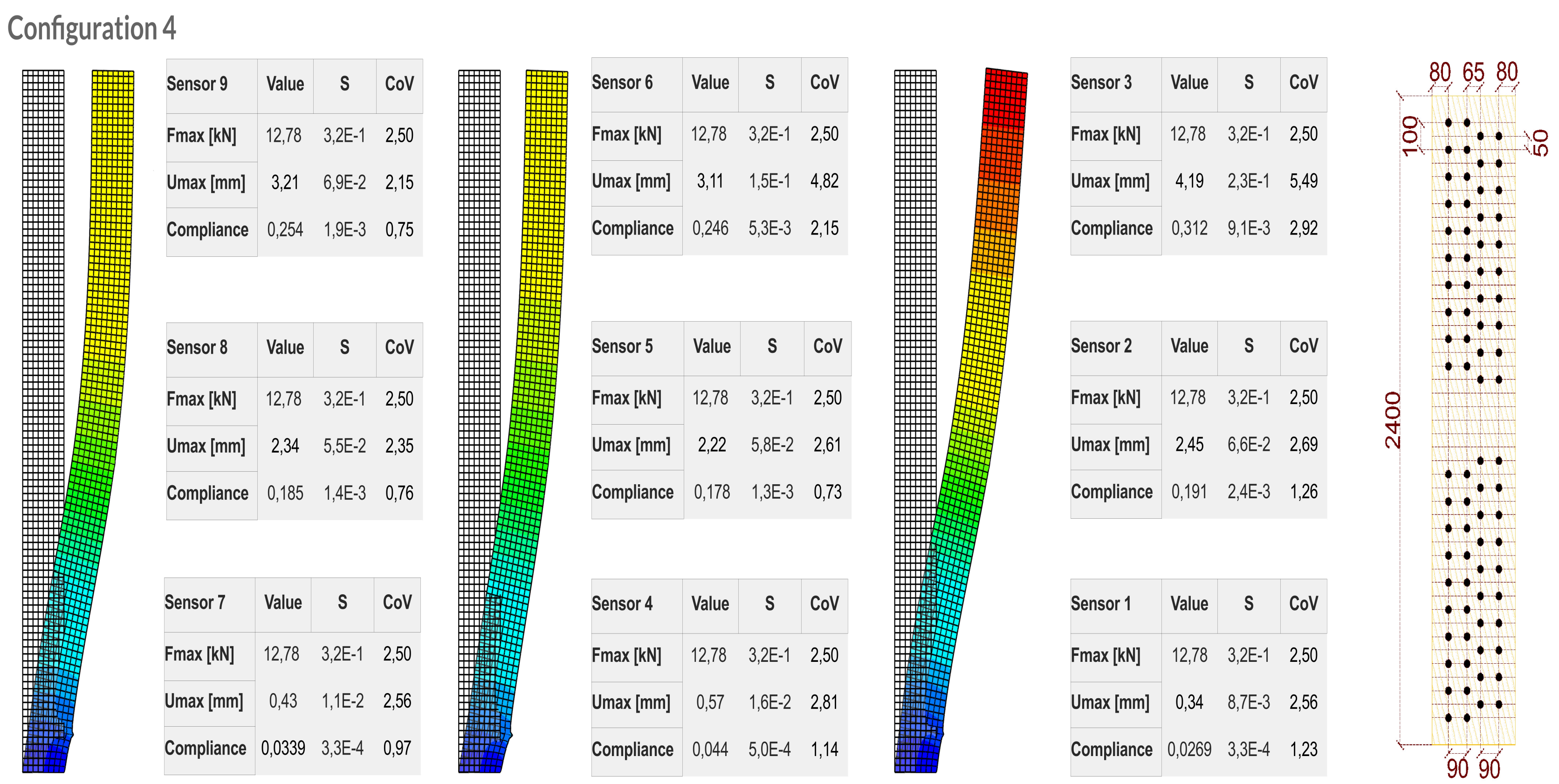


Figure 5.6: Configuration 3, main results



Sensor 1	Value	S	CoV
Fmax [kN]	12,78	3,2E-1	2,50
Umax [mm]	0,34	8,7E-3	2,56
Compliance	0,0269	3,3E-4	1,23

Sensor 2	Value	S	CoV
Fmax [kN]	12,78	3,2E-1	2,50
Umax [mm]	2,45	6,6E-2	2,69
Compliance	0,191	2,4E-3	1,26

Sensor 3	Value	S	CoV
Fmax [kN]	12,78	3,2E-1	2,50
Umax [mm]	4,19	2,3E-1	5,49
Compliance	0,312	9,1E-3	2,92

Sensor 4	Value	S	CoV
Fmax [kN]	12,78	3,2E-1	2,50
Umax [mm]	0,57	1,6E-2	2,81
Compliance	0,044	5,0E-4	1,14

Sensor 5	Value	S	CoV
Fmax [kN]	12,78	3,2E-1	2,50
Umax [mm]	2,22	5,8E-2	2,61
Compliance	0,178	1,3E-3	0,73

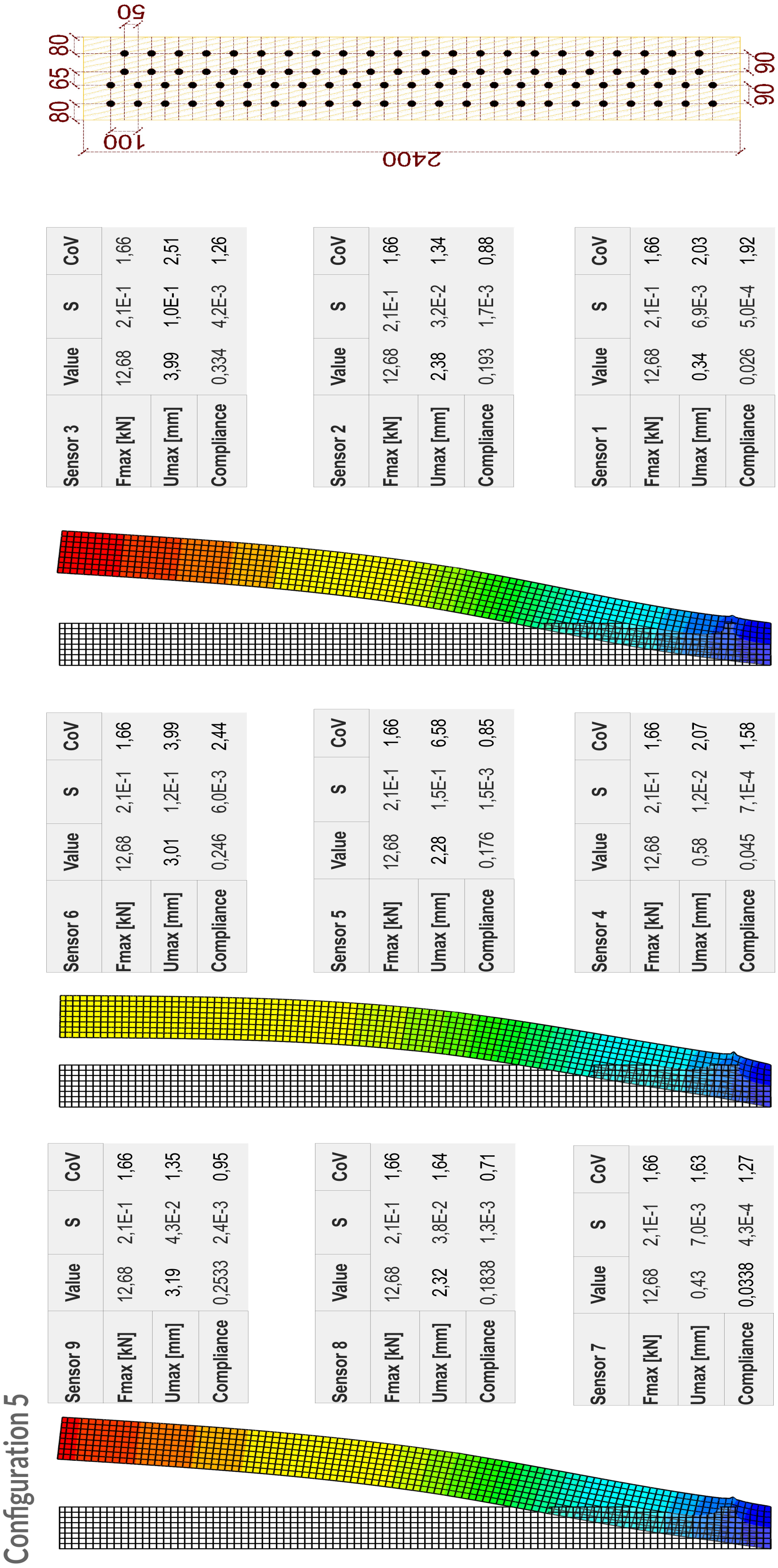
Sensor 6	Value	S	CoV
Fmax [kN]	12,78	3,2E-1	2,50
Umax [mm]	3,11	1,5E-1	4,82
Compliance	0,246	5,3E-3	2,15

Sensor 7	Value	S	CoV
Fmax [kN]	12,78	3,2E-1	2,50
Umax [mm]	0,43	1,1E-2	2,56
Compliance	0,0339	3,3E-4	0,97

Sensor 8	Value	S	CoV
Fmax [kN]	12,78	3,2E-1	2,50
Umax [mm]	2,34	5,5E-2	2,35
Compliance	0,185	1,4E-3	0,76

Sensor 9	Value	S	CoV
Fmax [kN]	12,78	3,2E-1	2,50
Umax [mm]	3,21	6,9E-2	2,15
Compliance	0,254	1,9E-3	0,75

Figure 5.7: Configuration 4, main results



Sensor 1	Value	S	CoV
Fmax [kN]	12,68	2,1E-1	1,66
Umax [mm]	0,34	6,9E-3	2,03
Compliance	0,026	5,0E-4	1,92

Sensor 2	Value	S	CoV
Fmax [kN]	12,68	2,1E-1	1,66
Umax [mm]	2,38	3,2E-2	1,34
Compliance	0,193	1,7E-3	0,88

Sensor 3	Value	S	CoV
Fmax [kN]	12,68	2,1E-1	1,66
Umax [mm]	3,99	1,0E-1	2,51
Compliance	0,334	4,2E-3	1,26

Sensor 4	Value	S	CoV
Fmax [kN]	12,68	2,1E-1	1,66
Umax [mm]	0,58	1,2E-2	2,07
Compliance	0,045	7,1E-4	1,58

Sensor 5	Value	S	CoV
Fmax [kN]	12,68	2,1E-1	1,66
Umax [mm]	2,28	1,5E-1	6,58
Compliance	0,176	1,5E-3	0,85

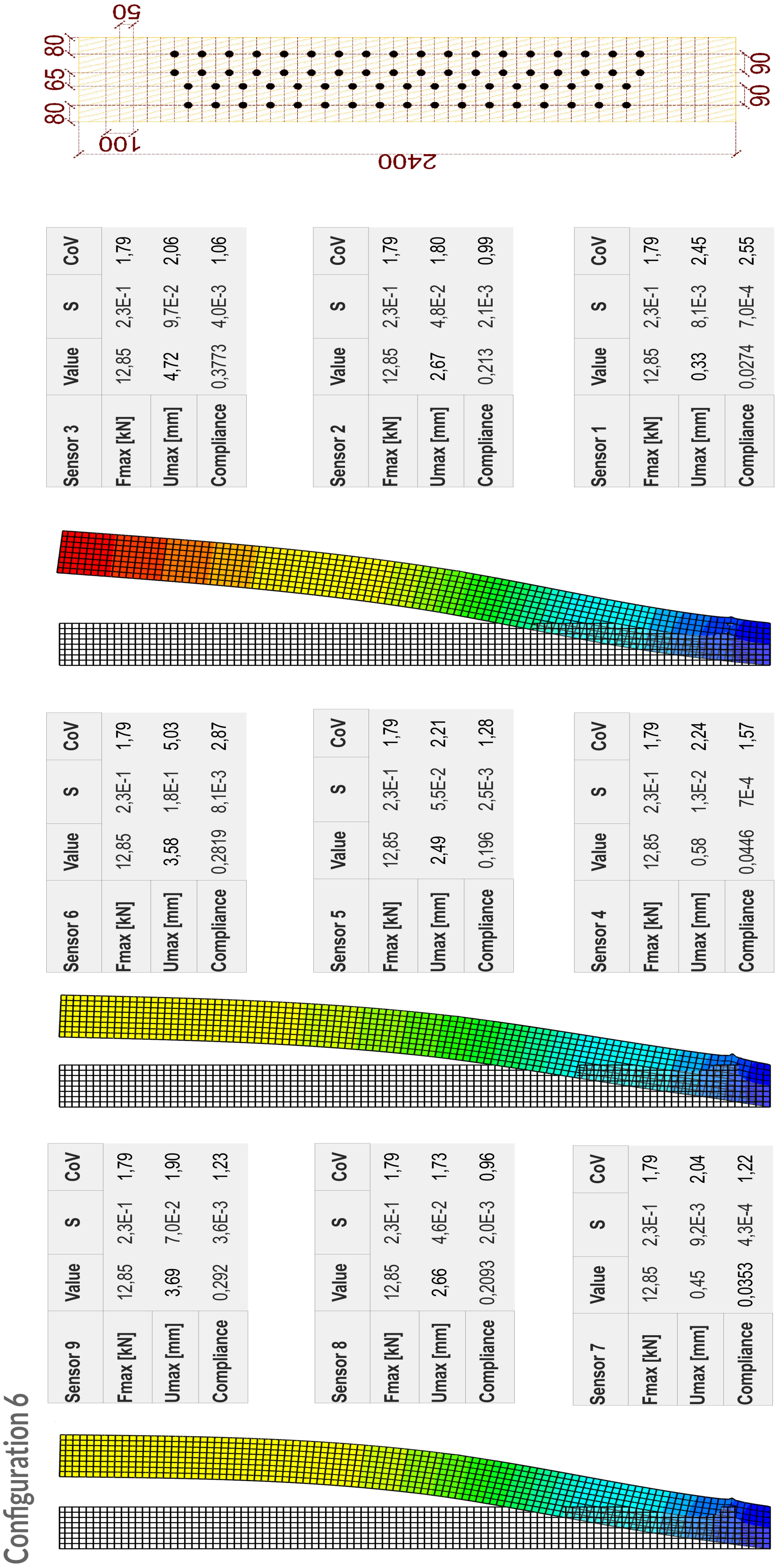
Sensor 6	Value	S	CoV
Fmax [kN]	12,68	2,1E-1	1,66
Umax [mm]	3,01	1,2E-1	3,99
Compliance	0,246	6,0E-3	2,44

Sensor 7	Value	S	CoV
Fmax [kN]	12,68	2,1E-1	1,66
Umax [mm]	0,43	7,0E-3	1,63
Compliance	0,0338	4,3E-4	1,27

Sensor 8	Value	S	CoV
Fmax [kN]	12,68	2,1E-1	1,66
Umax [mm]	2,32	3,8E-2	1,64
Compliance	0,1838	1,3E-3	0,71

Sensor 9	Value	S	CoV
Fmax [kN]	12,68	2,1E-1	1,66
Umax [mm]	3,19	4,3E-2	1,35
Compliance	0,2533	2,4E-3	0,95

Figure 5.8: Configuration 5, main results



Sensor 1	Value	S	CoV
Fmax [kN]	12,85	2,3E-1	1,79
Umax [mm]	0,33	8,1E-3	2,45
Compliance	0,0274	7,0E-4	2,55

Sensor 2	Value	S	CoV
Fmax [kN]	12,85	2,3E-1	1,79
Umax [mm]	2,67	4,8E-2	1,80
Compliance	0,213	2,1E-3	0,99

Sensor 3	Value	S	CoV
Fmax [kN]	12,85	2,3E-1	1,79
Umax [mm]	4,72	9,7E-2	2,06
Compliance	0,3773	4,0E-3	1,06

Sensor 4	Value	S	CoV
Fmax [kN]	12,85	2,3E-1	1,79
Umax [mm]	0,58	1,3E-2	2,24
Compliance	0,0446	7E-4	1,57

Sensor 5	Value	S	CoV
Fmax [kN]	12,85	2,3E-1	1,79
Umax [mm]	2,49	5,5E-2	2,21
Compliance	0,196	2,5E-3	1,28

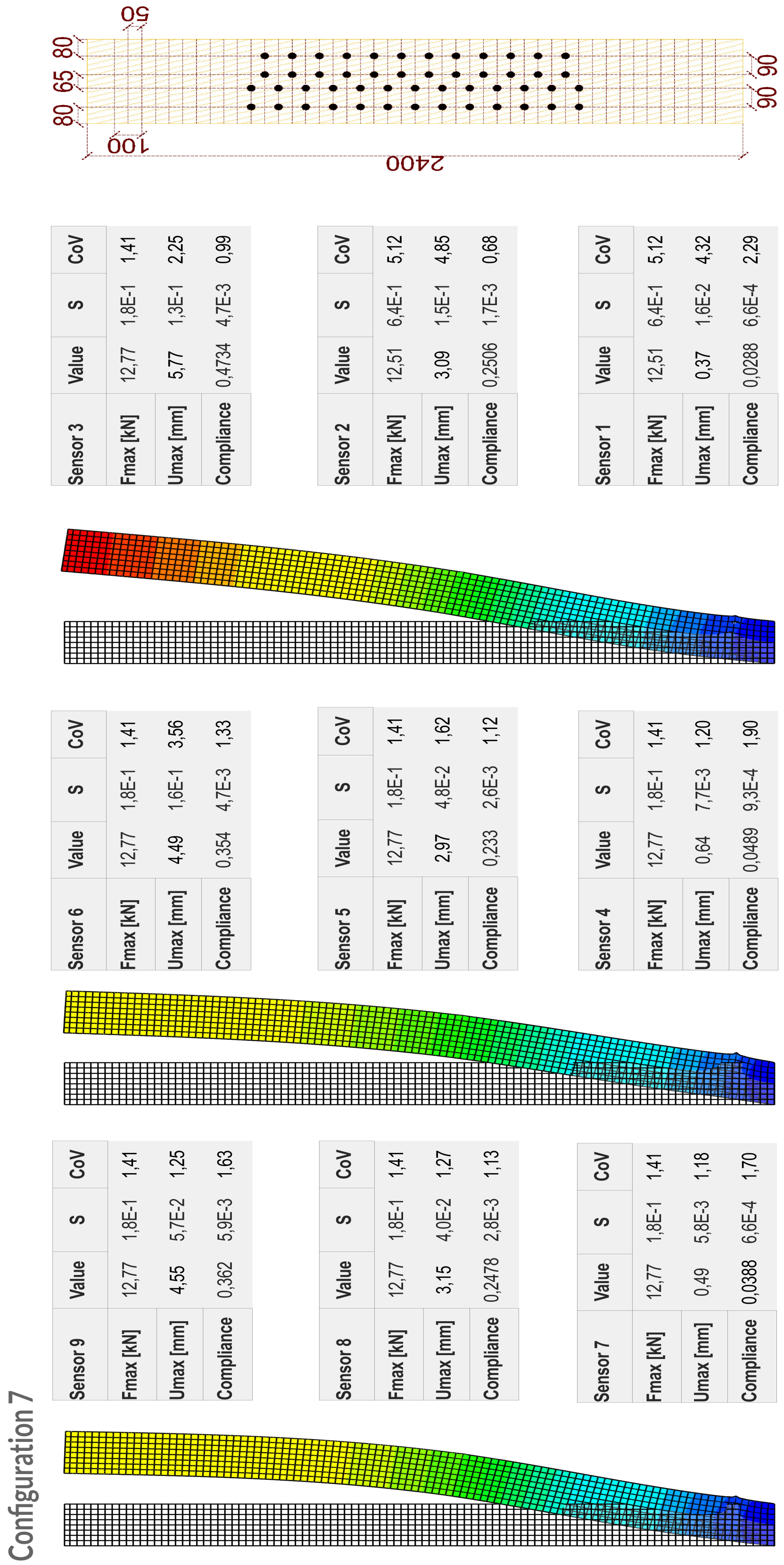
Sensor 6	Value	S	CoV
Fmax [kN]	12,85	2,3E-1	1,79
Umax [mm]	3,58	1,8E-1	5,03
Compliance	0,2819	8,1E-3	2,87

Sensor 7	Value	S	CoV
Fmax [kN]	12,85	2,3E-1	1,79
Umax [mm]	0,45	9,2E-3	2,04
Compliance	0,0353	4,3E-4	1,22

Sensor 8	Value	S	CoV
Fmax [kN]	12,85	2,3E-1	1,79
Umax [mm]	2,66	4,6E-2	1,73
Compliance	0,2093	2,0E-3	0,96

Sensor 9	Value	S	CoV
Fmax [kN]	12,85	2,3E-1	1,79
Umax [mm]	3,69	7,0E-2	1,90
Compliance	0,292	3,6E-3	1,23

Figure 5.9: Configuration 6, main results



Sensor 1	Value	S	CoV
Fmax [kN]	12,51	6,4E-1	5,12
Umax [mm]	0,37	1,6E-2	4,32
Compliance	0,0288	6,6E-4	2,29

Sensor 2	Value	S	CoV
Fmax [kN]	12,51	6,4E-1	5,12
Umax [mm]	3,09	1,5E-1	4,85
Compliance	0,2506	1,7E-3	0,68

Sensor 3	Value	S	CoV
Fmax [kN]	12,77	1,8E-1	1,41
Umax [mm]	5,77	1,3E-1	2,25
Compliance	0,4734	4,7E-3	0,99

Sensor 4	Value	S	CoV
Fmax [kN]	12,77	1,8E-1	1,41
Umax [mm]	0,64	7,7E-3	1,20
Compliance	0,0489	9,3E-4	1,90

Sensor 5	Value	S	CoV
Fmax [kN]	12,77	1,8E-1	1,41
Umax [mm]	2,97	4,8E-2	1,62
Compliance	0,233	2,6E-3	1,12

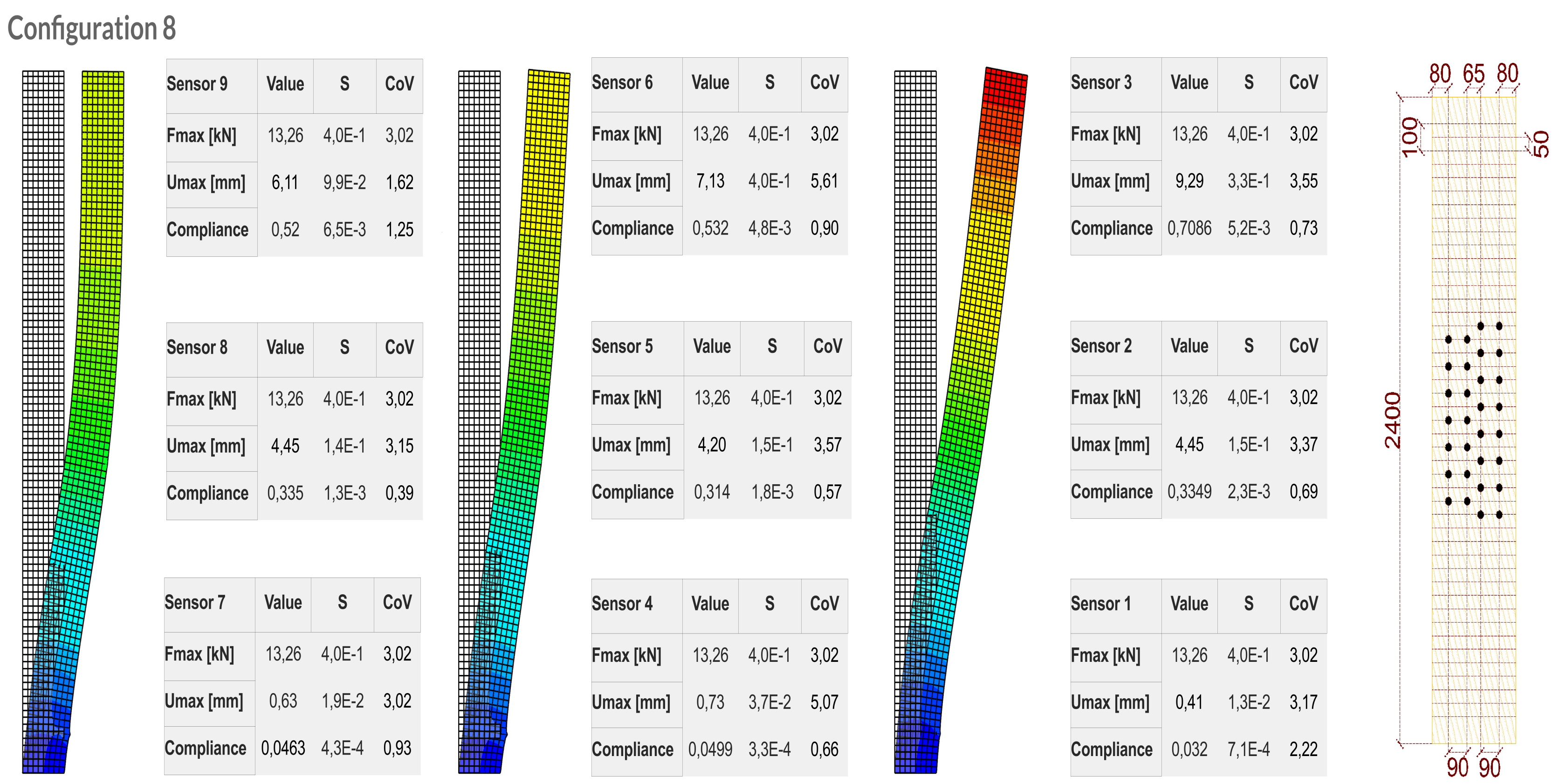
Sensor 6	Value	S	CoV
Fmax [kN]	12,77	1,8E-1	1,41
Umax [mm]	4,49	1,6E-1	3,56
Compliance	0,354	4,7E-3	1,33

Sensor 7	Value	S	CoV
Fmax [kN]	12,77	1,8E-1	1,41
Umax [mm]	0,49	5,8E-3	1,18
Compliance	0,0388	6,6E-4	1,70

Sensor 8	Value	S	CoV
Fmax [kN]	12,77	1,8E-1	1,41
Umax [mm]	3,15	4,0E-2	1,27
Compliance	0,2478	2,8E-3	1,13

Sensor 9	Value	S	CoV
Fmax [kN]	12,77	1,8E-1	1,41
Umax [mm]	4,55	5,7E-2	1,25
Compliance	0,362	5,9E-3	1,63

Figure 5.10: Configuration 7, main results



Sensor 9	Value	S	CoV
Fmax [kN]	13,26	4,0E-1	3,02
Umax [mm]	6,11	9,9E-2	1,62
Compliance	0,52	6,5E-3	1,25

Sensor 8	Value	S	CoV
Fmax [kN]	13,26	4,0E-1	3,02
Umax [mm]	4,45	1,4E-1	3,15
Compliance	0,335	1,3E-3	0,39

Sensor 7	Value	S	CoV
Fmax [kN]	13,26	4,0E-1	3,02
Umax [mm]	0,63	1,9E-2	3,02
Compliance	0,0463	4,3E-4	0,93

Sensor 6	Value	S	CoV
Fmax [kN]	13,26	4,0E-1	3,02
Umax [mm]	7,13	4,0E-1	5,61
Compliance	0,532	4,8E-3	0,90

Sensor 5	Value	S	CoV
Fmax [kN]	13,26	4,0E-1	3,02
Umax [mm]	4,20	1,5E-1	3,57
Compliance	0,314	1,8E-3	0,57

Sensor 4	Value	S	CoV
Fmax [kN]	13,26	4,0E-1	3,02
Umax [mm]	0,73	3,7E-2	5,07
Compliance	0,0499	3,3E-4	0,66

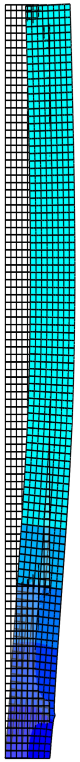
Sensor 3	Value	S	CoV
Fmax [kN]	13,26	4,0E-1	3,02
Umax [mm]	9,29	3,3E-1	3,55
Compliance	0,7086	5,2E-3	0,73

Sensor 2	Value	S	CoV
Fmax [kN]	13,26	4,0E-1	3,02
Umax [mm]	4,45	1,5E-1	3,37
Compliance	0,3349	2,3E-3	0,69

Sensor 1	Value	S	CoV
Fmax [kN]	13,26	4,0E-1	3,02
Umax [mm]	0,41	1,3E-2	3,17
Compliance	0,032	7,1E-4	2,22

Figure 5.11: Configuration 8, main results

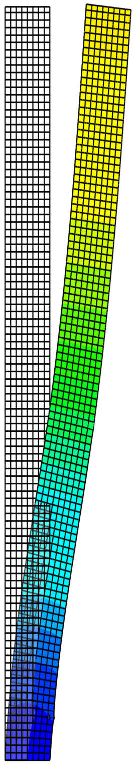
Configuration 9



Sensor 9	Value	S	CoV
Fmax [kN]	12,62	1,8E-1	1,43
Umax [mm]	5,80	1,2E-1	2,07
Compliance	0,6186	2,4E-2	3,88

Sensor 8	Value	S	CoV
Fmax [kN]	12,62	1,8E-1	1,43
Umax [mm]	6,36	6,1E-2	0,96
Compliance	0,59	2,1E-2	3,56

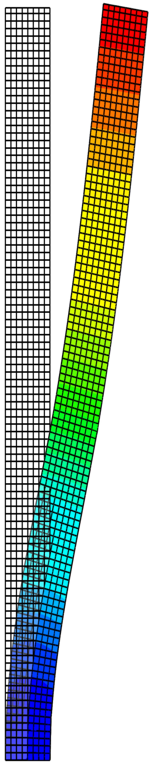
Sensor 7	Value	S	CoV
Fmax [kN]	12,62	1,8E-1	1,43
Umax [mm]	1,51	1,6E-2	1,06
Compliance	0,12	1,3E-3	1,08



Sensor 6	Value	S	CoV
Fmax [kN]	12,13	4,0E-1	3,29
Umax [mm]	22,78	3,0E-2	0,13
Compliance	1,787	6,5E-2	3,64

Sensor 5	Value	S	CoV
Fmax [kN]	12,62	1,8E-1	1,43
Umax [mm]	12,28	5,7E-2	0,46
Compliance	1,01	8,0E-3	0,79

Sensor 4	Value	S	CoV
Fmax [kN]	12,13	4,0E-1	3,29
Umax [mm]	1,25	2,4E-2	1,92
Compliance	0,0974	2,2E-3	2,26



Sensor 3	Value	S	CoV
Fmax [kN]	12,13	4,0E-1	3,29
Umax [mm]	27,57	6,5E-1	2,36
Compliance	1,249	8,6E-1	68,86

Sensor 2	Value	S	CoV
Fmax [kN]	12,62	1,8E-1	1,43
Umax [mm]	13,43	2,4E-1	1,79
Compliance	1,044	9,1E-3	0,87

Sensor 1	Value	S	CoV
Fmax [kN]	12,36	5,4E-1	4,37
Umax [mm]	0,28	1,2E-1	42,86
Compliance	0,0178	2,6E-3	14,61

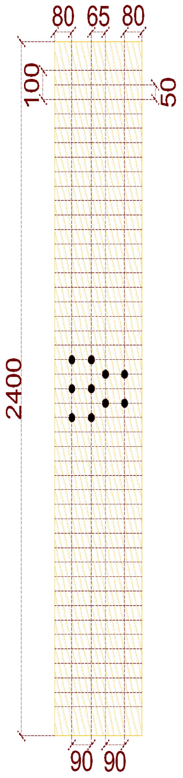


Figure 5.12: Configuration 9, main results

Table 5.1 summarizes the averaged max displacement values registered in each sensor, for all configurations. All cycles, 8 in each series, are averaged and summed through three series for each sensor, respectively.

	Displacement (mm)								
Config.	**Sensor 1**	**Sensor 2**	**Sensor 3**	**Sensor 4**	**Sensor 5**	**Sensor 6**	**Sensor 7**	**Sensor 8**	**Sensor 9**
0	1,71	20,54	45,49	1,32	9,5	16,32	1,20	6,17	6,02
1	NaN[1]	2,71	3,91	NaN	2,63	3,47	NaN	2,75	3,84
2	0,35	2,49	4,00	0,61	2,35	3,3	0,44	2,48	3,39
3	0,35	2,47	4,03	0,61	2,30	3,17	0,37	2,44	3,45
4	0,34	2,45	4,19	0,57	2,22	3,11	0,43	2,34	3,21
5	0,34	2,38	3,99	0,58	2,28	3,01	0,43	2,32	3,19
6	0,33	2,67	4,72	0,58	2,49	3,58	0,45	2,66	3,69
7	0,37	3,09	5,77	0,64	2,97	4,49	0,49	3,15	4,55
8	0,41	4,45	9,29	0,73	4,20	7,13	0,63	4,45	6,11
9	0,28	13,43	27,57	1,25	12,28	22,78	1,51	6,36[2]	5,80[3]

[1]- NaN (no number available) [2,3]- Sensor out of bound

Table 5.1: Horizontal displacements of all sensors with respect to configurations

By partitioning the screws into configurations, as done in this thesis, it becomes difficult to compare and visualize them to another with just assigned numbers and obtained displacement values. However, Steiner's theorem can be used to make them better suited for comparison.

It is obvious that the effectiveness of the fastener increase proportional to the distance from the neutral axis of the CLT element. To better illustrate the effect due to an increase in the number of screws, we can rearrange the configurations with respect to their effectiveness. If the stiffness of the screws are set to 1, each configuration is then converted to a sum of distances, as seen in Figure 5.13 and Equation 5.1.

$$R^2 = \sum (r_1)^2 + (r_2)^2 + ... + (r_n)^2 \tag{5.1}$$

where:

r - is the distance from center of the fastener n, to the N.A. of the CLT panel,
see Figure 5.13

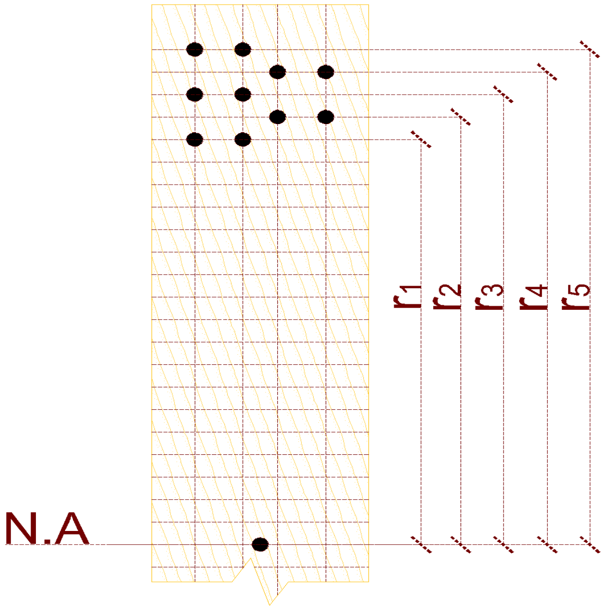


Figure 5.13: Fastener distance to N.A.

The new representation, arranged from lowest to highest, is presented in Figure 5.14 with its associated values listed in Table 5.2.

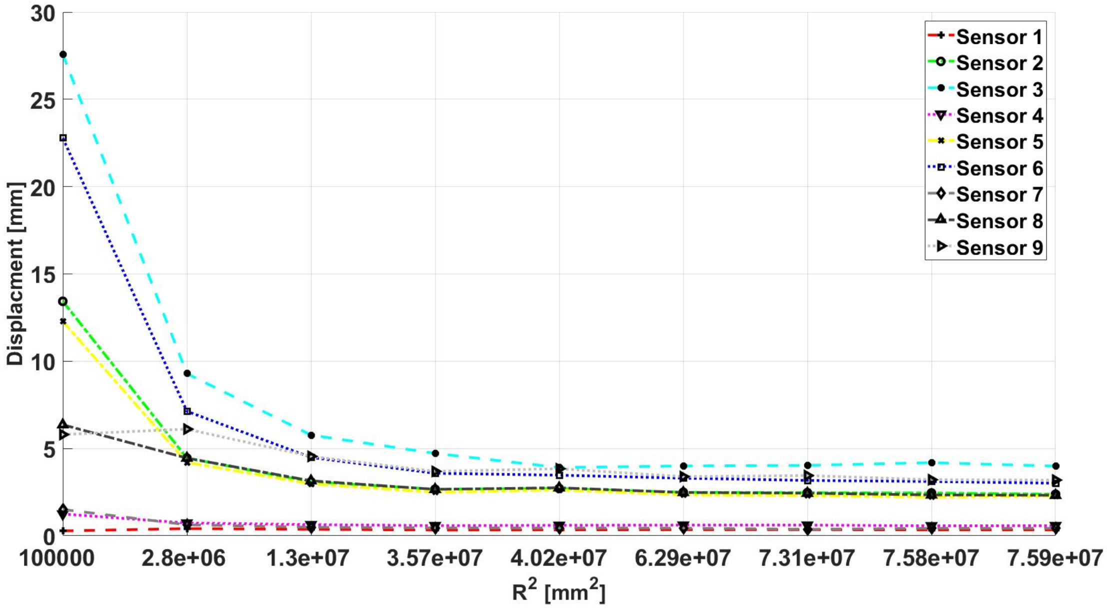


Figure 5.14: The horizontal displacement for all sensors arranged by R^2

Configuration	9	8	7	6	1	2	3	4	5
R^2 * 1000 mm^2	100	2800	13000	35700	40200	62 900	73100	75800	75900

Table 5.2: Configurations converted into R^2- values

5.1.2 Dynamics

By calculating the enclosed area of the hysteresis loops, illustrated in Figures 5.1a - 5.2b, the dissipated energy at the location of the sensors are obtained. If the mock-up at Charlottenlund is considered a single degree of freedom system, where the only allowed deformation is a horizontal displacement located at sensor 3, see Figure 5.15, it can be assumed that the total damping of the system is represented by the dissipated energy, displacement and force measured at this position.

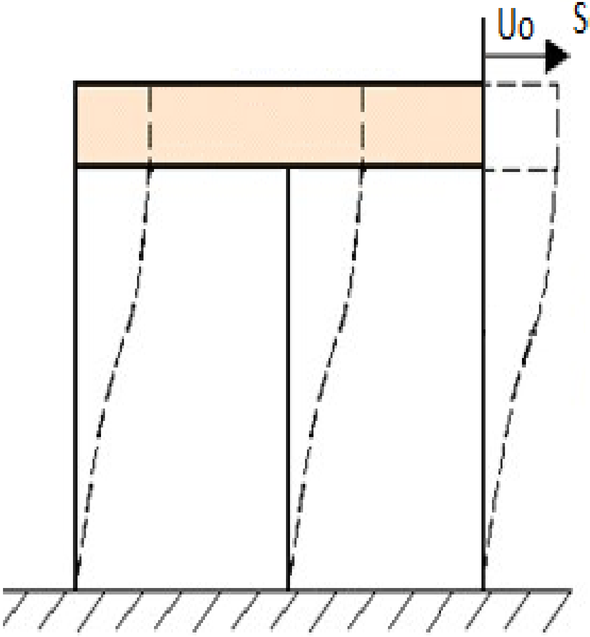
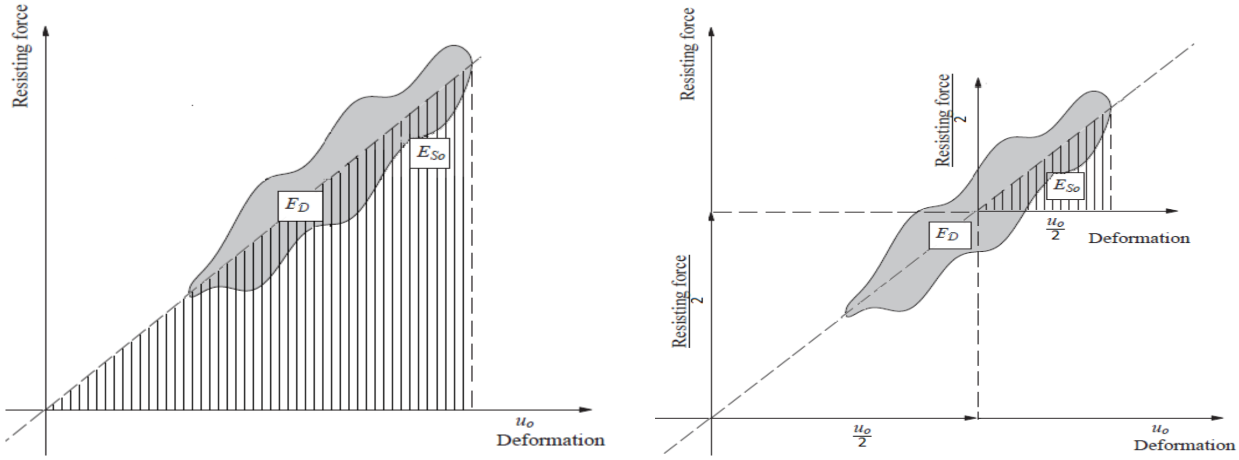


Figure 5.15: A single degree of freedom system

As presented in Chapter 2.4, the equation for calculating an equivalent viscous damping, is given by Equation 2.6. However, in our experiment, there was only a tension force applied to the system, and therefore some assumptions have to be made in order to use the theory presented. The first assumption is that a new local coordinate system is created within the global coordinate system, so that the hysteresis loop represents both a tension and a compression relationship. Further, we need to assume that the coordinate system is placed exactly in the middle of the maximum deformation and applied force, so that the local maximum deformation and applied force is only half of the measured values. This would effectively mean that the dissipated energy values are scaled by a factor of $\frac{1}{2}$ for both the height and length resulting in an area of $\frac{1}{4}$ of the measured area. The static energy is also scaled by a factor of $\frac{1}{4}$, as the maximum deformation and forced applied is assumed to be halved. By taking this into account, Equation 2.6 remains unchanged, as shown by Equation 5.2:

$$\zeta_{eq} = \frac{1}{4\pi} \cdot \frac{\frac{E_D}{4}}{\frac{E_{so}}{4}} \zeta_{eq} = \frac{1}{4\pi} \cdot \frac{E_D}{E_{so}} \tag{5.2}$$

Figure 5.16 shows the steps in the assumptions made.



(a) The actual situation during the experiment

(b) Applying a local coordinate system in the middle of hysteresis

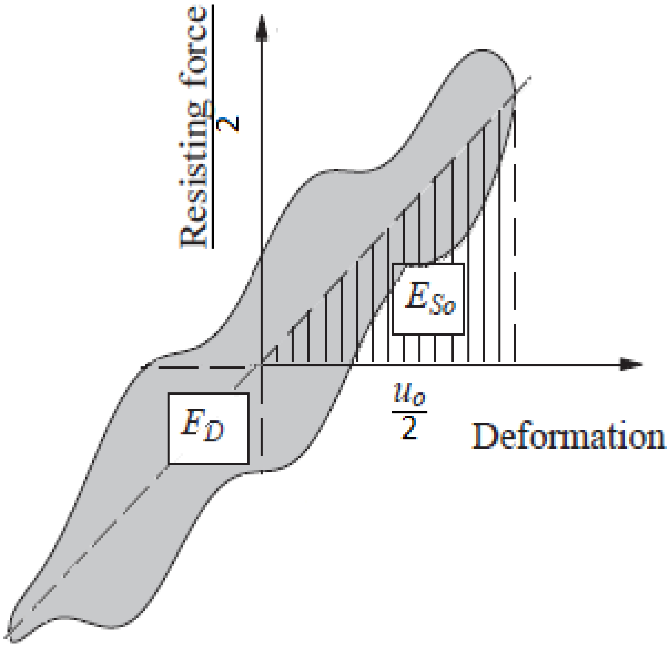


Figure 5.16: The final situation based on presented assumptions

A visualisation of the dissipated energy from sensor 3 is disclosed in Figure 5.17 - 5.21, denoted with its respective configuration.

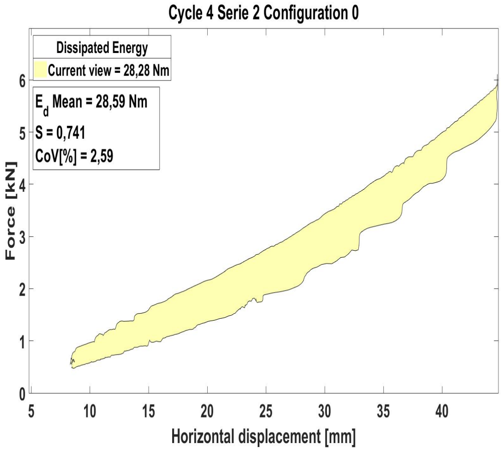


Figure 5.17: Energy dissipation, Configuration 0

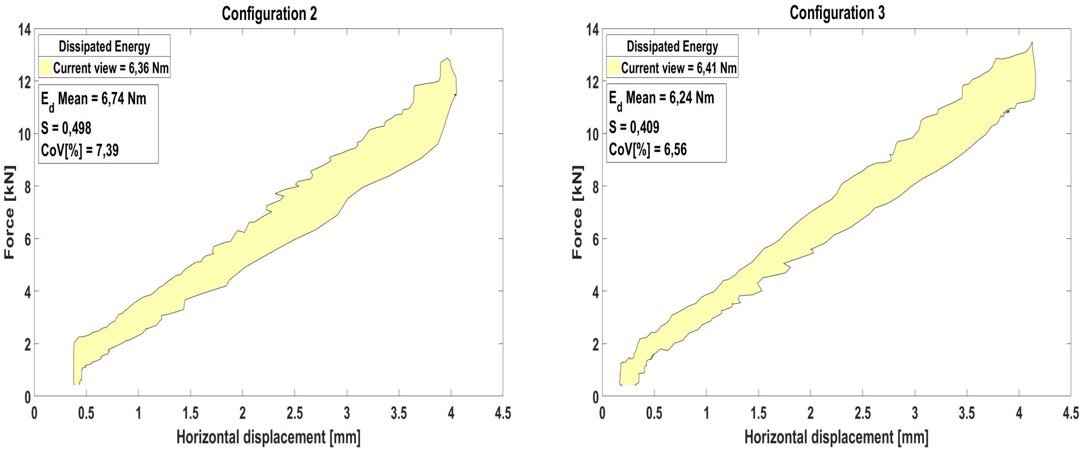


Figure 5.18: Energy dissipation, Configuration 2 & 3

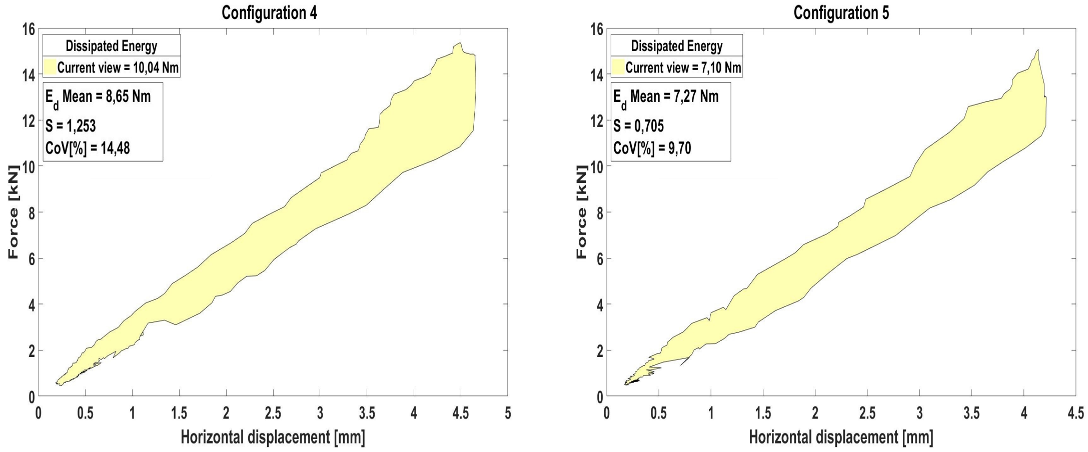


Figure 5.19: Energy dissipation, Configuration 4 & 5

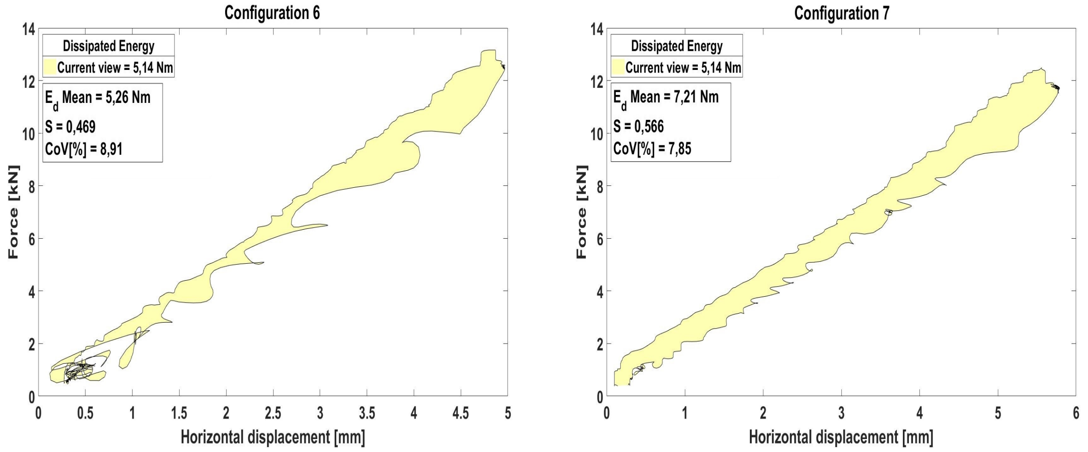


Figure 5.20: Energy dissipation, Configuration 6 & 7

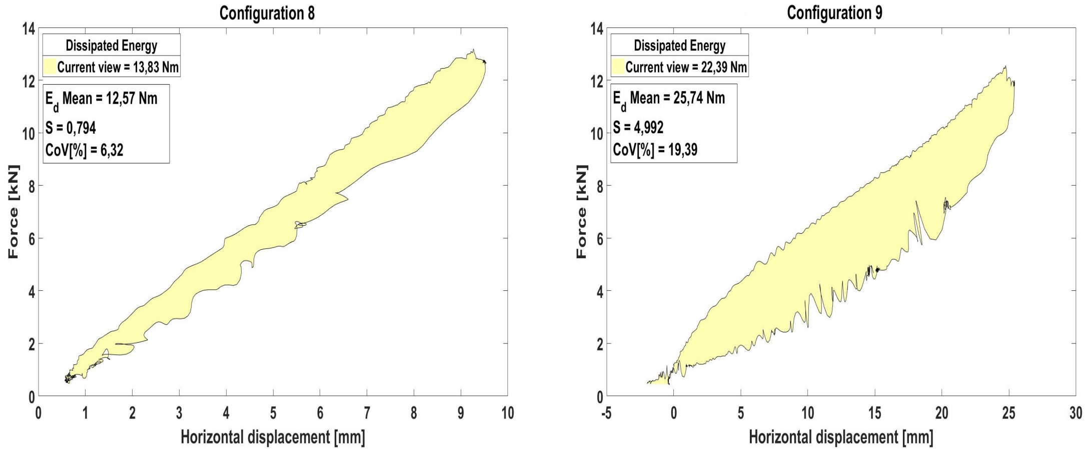


Figure 5.21: Energy dissipation, Configuration 8 & 9

The damping of the system is presented in Table 5.3. Dissipated- and static energy are presented as follows: $X\binom{Y}{Z}$ where X is the average value, Y is the standard deviation and Z is the coefficient of variation.

Config.	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Dissipated energy	$28,60\binom{0.74}{2,59}$	$7,63\binom{0,72}{9,44}$	$6,74\binom{0.49}{7,39}$	$7,61\binom{0,41}{6,56}$	$8,66\binom{0,41}{14,48}$	$7,38\binom{0,55}{7,47}$	$5,36\binom{0,45}{8,47}$	$7,21\binom{0,57}{7,85}$	$12,57\binom{0.79}{6,32}$	$66,13\binom{4,97}{7,51}$
Static energy	$121,18\binom{1,27}{1,05}$	$29,30\binom{2,52}{8,59}$	$25,68\binom{1,57}{6,12}$	$26,17\binom{1,46}{5,71}$	$28,44\binom{3,46}{12,15}$	$22,56\binom{2,37}{10,51}$	$29,11\binom{1,05}{3,62}$	$35,41\binom{1,14}{3,21}$	$56,33\binom{4,60}{8,17}$	$160,45\binom{4,86}{3,03}$
ζ_{eq} [%]	1,88	2,07	2,09	2,35	2,42	2,60	1,47	1,62	1,78	3,28

Table 5.3: Damping of the system

The information of dissipated energy from the other sensors, can tell where some of the energy is dissipated in the system. Table 5.4 shows the average dissipated energy in each of the sensor locations, for all configurations. The top row is the sensor number, S1 = sensor 1 etc, and all dissipated values are described as in Table 5.3.

	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**
Config. 0	$1,31\binom{0,12}{9,04}$	$12,49\binom{0.14}{1,12}$	$28,60\binom{0.74}{2,59}$	$0,939\binom{0,05}{5,3}$	$7,06\binom{0,28}{3,97}$	$15,36\binom{0,42}{2,75}$	$0,74\binom{0,01}{9,73}$	$3,39\binom{0,76}{22,38}$	$2,32\binom{0,53}{24,42}$
Config. 1	NaN	$3,78\binom{0,35}{9,34}$	$7,63\binom{0,72}{9,44}$	NaN	$3,79\binom{0,33}{8,66}$	$7,82\binom{0,64}{8,13}$	NaN	$3,35\binom{0,11}{9,73}$	$6,32\binom{0,70}{11,03}$
Config. 2	$0,40\binom{0,01}{3,72}$	$3,16\binom{0,03}{4,99}$	$6,74\binom{0.49}{7,39}$	$0,97\binom{0,04}{4,12}$	$2,98\binom{0,18}{6,00}$	$5,62\binom{0,33}{6,03}$	$0,51\binom{0,01}{5,31}$	$2,67\binom{0,10}{3,72}$	$4,68\binom{0,31}{6,052}$
Config. 3	$0,38\binom{0,026}{6,93}$	$3,15\binom{0,19}{6,02}$	$7,61\binom{0,41}{6,56}$	$1,00\binom{0,07}{6,80}$	$2,97\binom{0,29}{9,89}$	$5,54\binom{0,46}{8,32}$	$0,44\binom{0,01}{13,40}$	$2,49\binom{0,15}{5,91}$	$4,32\binom{0,29}{6,72}$
Config. 4	$0,50\binom{0,03}{6,60}$	$3,17\binom{0,41}{12,82}$	$8,66\binom{0,41}{14,48}$	$0,77\binom{0.05}{6,72}$	$2,93\binom{0,22}{7,69}$	$6,00\binom{0,38}{6,35}$	$0,48\binom{0,01}{7,01}$	$2,15\binom{0,13}{5,88}$	$3,82\binom{0,22}{5,66}$
Config. 5	$0,45\binom{0,03}{6,22}$	$3,09\binom{0,17}{5,45}$	$7,38\binom{0,55}{7,47}$	$0,81\binom{0,05}{5,57}$	$2,87\binom{0,33}{11,33}$	$6,07\binom{0,56}{9,37}$	$0,54\binom{0,01}{6,12}$	$2,27\binom{0,10}{4,61}$	$4,13\binom{0,04}{4,76}$
Config. 6	$0,51\binom{0,03}{5,78}$	$3,07\binom{0,17}{5,43}$	$5,36\binom{0,45}{8,47}$	$0,81\binom{0,04}{5,40}$	$2,31\binom{0,36}{10,76}$	$6,32\binom{0,71}{11,22}$	$0,54\binom{0,02}{4,44}$	$2,95\binom{0,34}{11,42}$	$5,32\binom{0,38}{7,06}$
Config. 7	$0,39\binom{0,04}{9,22}$	$3,37\binom{0,17}{4,94}$	$7,21\binom{0,57}{7,85}$	$0,89\binom{0,06}{7,20}$	$3,54\binom{0,30}{8,80}$	$6,36\binom{0,36}{5,68}$	$0,57\binom{0,01}{6,66}$	$3,22\binom{0,20}{6,29}$	$6,02\binom{0,36}{6,00}$
Config. 8	$0,45\binom{0,04}{8,60}$	$5,36\binom{0,30}{5,70}$	$12,57\binom{0.79}{6,32}$	$0,72\binom{0.06}{8,61}$	$6,02\binom{0,28}{8,83}$	$14,51\binom{0,97}{6,66}$	$0,66\binom{0,01}{5,24}$	$5,31\binom{0,28}{5,35}$	$6,62\binom{0,59}{8,95}$
Config. 9	$0,05\binom{0,06}{1,31}$	$37,81\binom{1,79}{4,73}$	$82,46\binom{3,68}{4,46}$	$2,18\binom{0,09}{4,04}$	$31,31\binom{2,08}{6,66}$	$66,13\binom{4,97}{7,51}$	$2,03\binom{0,13}{6,37}$	$9,75\binom{1,58}{16,22}$	$5,32\binom{0,70}{18,11}$

Table 5.4: Energy dissipation

5.2 Numerical results

5.2.1 Displacements

The numerical model was updated to match the experimental results after the tests were completed. The Stiffness of the fasteners was updated to match the results within reasonable limits and the final results are presented in Table 5.5.

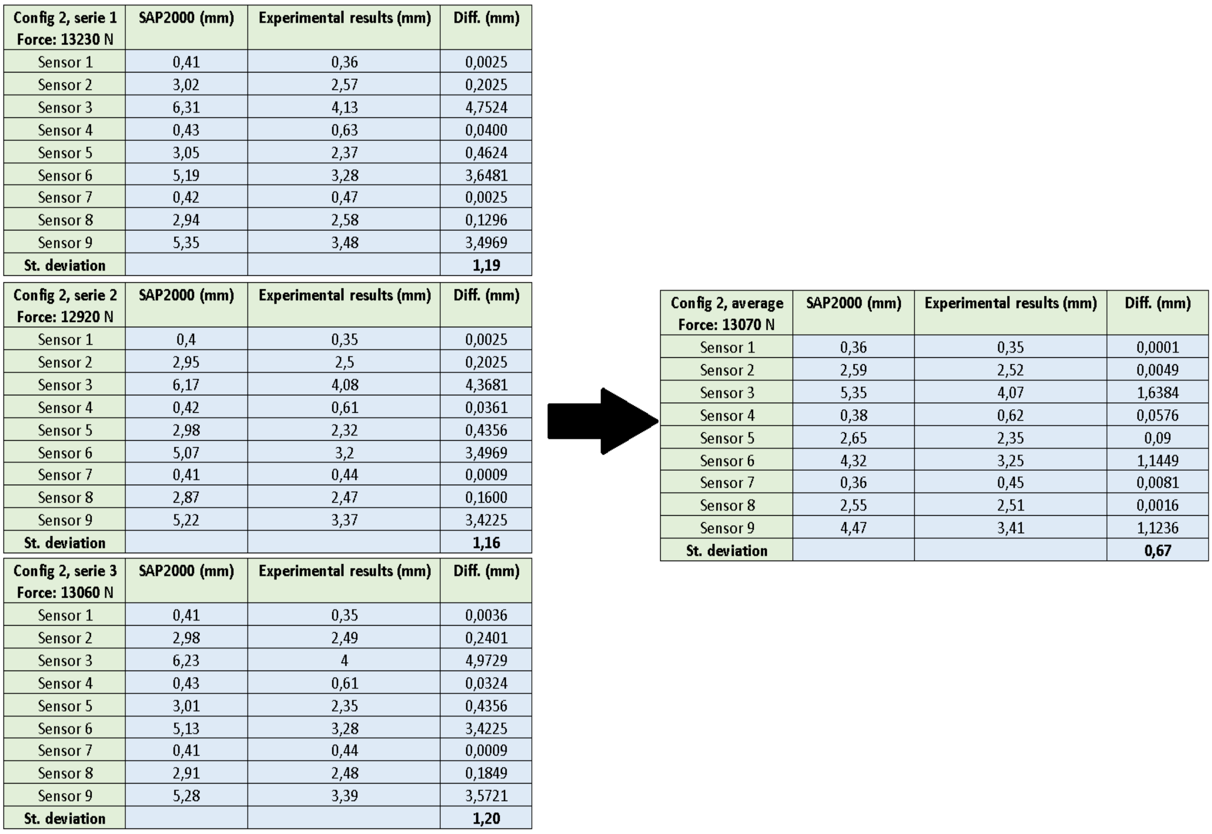
	U1 **N/mm**	**U2** **N/mm**	**U3** **N/mm**	**R1** **Nmm**	**R2** **Nmm**	**R3** **Nmm**
Pre	16800	8250	8250	10,0E+6	10,0E+6	10.0E+6
Post	16800	10000	10000	20,0E+6	20,0E+6	20,0E+6

Table 5.5: Pre - and post calibrated stiffness values for fasteners

Average values for both pre- and post-calibrated results are presented in Table 5.6, as standard deviations of the averaged displacement. Pre-calibrated values are presented in three series, while final results from the post-calibrated model are presented as the average of the three series. All configurations are presented with Δ S describing the difference between pre- and post-calibrated results. The last column, %, presents the increase in accuracy after the model was calibrated. Figure 5.22 illustrates how each standard deviation was established by use of Equation 5.3.

$$St.deviation = \sqrt{\frac{\sum(Sensor_{i,model} - Sensor_{i,experiment})^2}{\#\ of valid sensors}} \tag{5.3}$$

The table on the right side displays the results when both force and displacements are averaged from the three series.



Config 2, serie 1 Force: 13230 N	SAP2000 (mm)	Experimental results (mm)	Diff. (mm)
Sensor 1	0,41	0,36	0,0025
Sensor 2	3,02	2,57	0,2025
Sensor 3	6,31	4,13	4,7524
Sensor 4	0,43	0,63	0,0400
Sensor 5	3,05	2,37	0,4624
Sensor 6	5,19	3,28	3,6481
Sensor 7	0,42	0,47	0,0025
Sensor 8	2,94	2,58	0,1296
Sensor 9	5,35	3,48	3,4969
St. deviation			**1,19**

Config 2, serie 2 Force: 12920 N	SAP2000 (mm)	Experimental results (mm)	Diff. (mm)
Sensor 1	0,4	0,35	0,0025
Sensor 2	2,95	2,5	0,2025
Sensor 3	6,17	4,08	4,3681
Sensor 4	0,42	0,61	0,0361
Sensor 5	2,98	2,32	0,4356
Sensor 6	5,07	3,2	3,4969
Sensor 7	0,41	0,44	0,0009
Sensor 8	2,87	2,47	0,1600
Sensor 9	5,22	3,37	3,4225
St. deviation			**1,16**

Config 2, serie 3 Force: 13060 N	SAP2000 (mm)	Experimental results (mm)	Diff. (mm)
Sensor 1	0,41	0,35	0,0036
Sensor 2	2,98	2,49	0,2401
Sensor 3	6,23	4	4,9729
Sensor 4	0,43	0,61	0,0324
Sensor 5	3,01	2,35	0,4356
Sensor 6	5,13	3,28	3,4225
Sensor 7	0,41	0,44	0,0009
Sensor 8	2,91	2,48	0,1849
Sensor 9	5,28	3,39	3,5721
St. deviation			**1,20**

Config 2, average Force: 13070 N	SAP2000 (mm)	Experimental results (mm)	Diff. (mm)
Sensor 1	0,36	0,35	0,0001
Sensor 2	2,59	2,52	0,0049
Sensor 3	5,35	4,07	1,6384
Sensor 4	0,38	0,62	0,0576
Sensor 5	2,65	2,35	0,09
Sensor 6	4,32	3,25	1,1449
Sensor 7	0,36	0,45	0,0081
Sensor 8	2,55	2,51	0,0016
Sensor 9	4,47	3,41	1,1236
St. deviation			**0,67**

Figure 5.22: Pre- and post calibration comparison

	Pre cal. (mm)			**Post.cal (mm)**	**ΔS (mm)**	**%**
Config.	**1**	**2**	**3**	**Average**		
0	NaN	NaN	NaN	NaN	NaN	NaN
1	2,89	3,72	3,04	1,86	1,36	42,2
2	1,19	1,16	1,20	0,67	0,51	43,2
3	1,06	0,84	0,84	0,52	0,39	42,9
4	0,60	0,74	0,57	0,32	0,32	50,0
5	0,65	0,67	0,55	0,33	0,29	46,8
6	0,86	0,89	0,98	0,54	0,37	40,7
7	2,01	2,24	2,17	1,57	0,57	26,6
8	5,88	6,56	7,00	5,44	1,04	16,1
9	11,48	17,23	16,53	13,13	1,95	12,9

Table 5.6: Pre- and post calibrated displacement values
in SAP2000

To further test the updated model, two modifications were performed on *Configuration 1* to see if the model could handle and give reasonable results for other types of configurations. *Modification 1* contains the same amount of screws, but spaced out equally throughout the height of the CLT panel. In *Modification 2*, the angle of the screws are changed from 30 deg to 0 deg, i.e perpendicular to the surface, but the layout is unchanged from the original. The results can be seen in Table 5.7.

Sensor	**1 (mm)**	**2 (mm)**	**3 (mm)**	**4 (mm)**	**5 (mm)**	**6 (mm)**	**7 (mm)**	**8 (mm)**	**9 (mm)**
Configuration 1	0,46	3,39	7,09	0,47	3,34	5,87	0,46	3,23	6,02
Modification 1	0,48	3,51	7,51	0,50	3,55	6,30	0,49	3,47	6,46
Modification 2	0,40	2,91	6,09	0,41	2,83	4,67	0,39	2,74	4,83

Table 5.7: Displacement comparison with modifications

5.2.2 Modal analysis in post calibrated model

Modal analysis of the post-calibrated model, for all configurations, are shown in Table 5.8. Figure 5.23 shows a visualisation of the first mode for all configurations arranged in increasing order. The first mode is a translation of the system in the same direction as the "effective" direction of the panel, i.e the weak direction of the frame. The second mode is a displacement in the same direction as the moment resisting frames. The third mode is a twisting mode of the slabs and columns. Figure 5.24 - Figure 5.26 shows these modes.

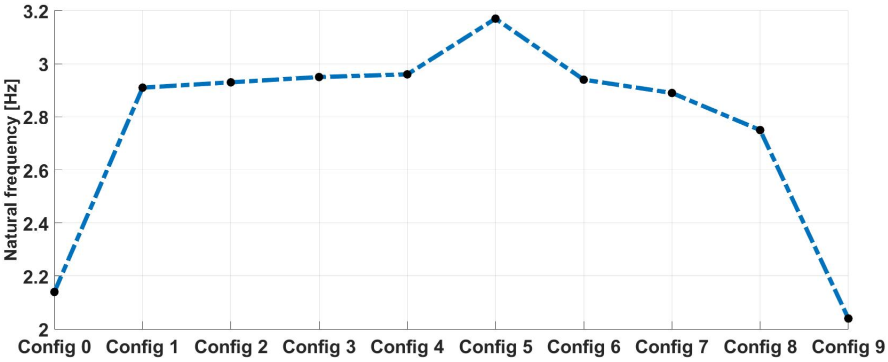


Figure 5.23: Natural frequencies for mode shape 1

Config.	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Mode 1 [Hz]	2,14	2,91	2,93	2,95	2,96	3,17	2,94	2,89	2,75	2,04
Mode 2 [Hz]	3,70	4,56	4,54	4,55	4,56	4,48	4,56	4,53	4,36	3,40
Mode 3 [Hz]	4,93	6,39	6,99	7,28	7,42	7,46	6,83	5,77	4,57	4,52

Table 5.8: Natural frequency

Config	Mode 1 [Hz]
0	2,14
1	2,91
2	2,93
3	2,95
4	2,96
5	3,17
6	2,94
7	2,89
8	2,75
9	2,04

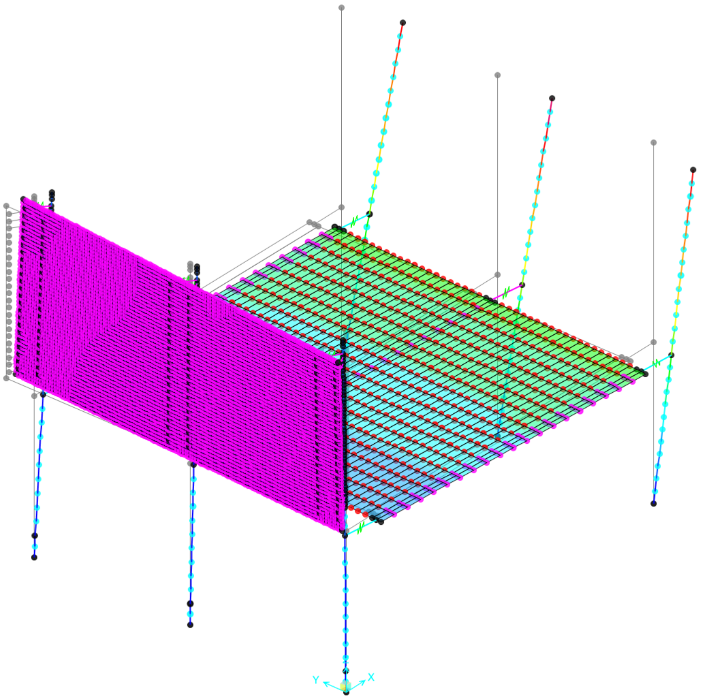


Figure 5.24: Mode 1, in-plane deformation

Config	Mode 2 [Hz]
0	3,70
1	4,56
2	4,54
3	4,55
4	4,56
5	4,48
6	4,56
7	4,53
8	4,36
9	3,40

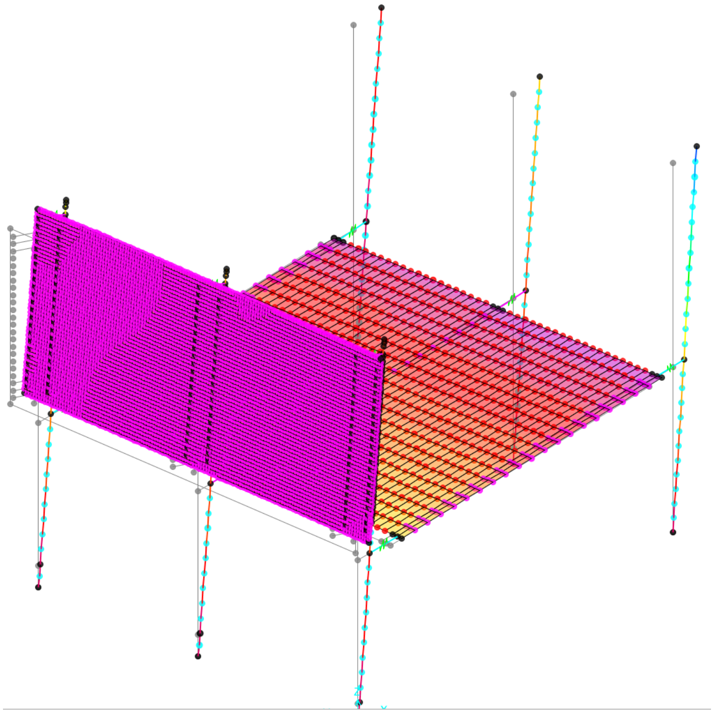


Figure 5.25: Mode 2, out of plane deformation

Config	**Mode 3 [Hz]**
0	**4,93**
1	**6,39**
2	**6,99**
3	**7,28**
4	**7,42**
5	**7,46**
6	**6,83**
7	**5,77**
8	**4,57**
9	**4,52**

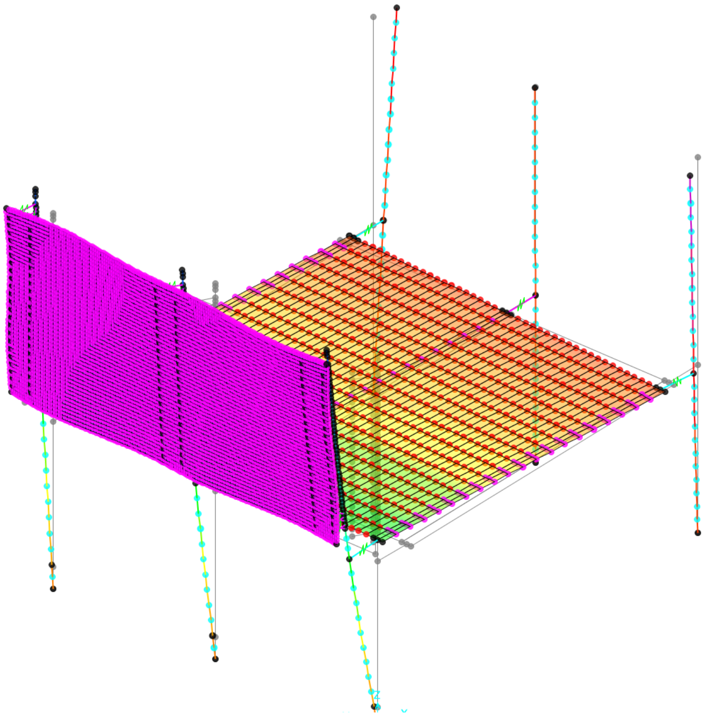


Figure 5.26: Mode 3, in-plane deformation

Chapter 6

Evaluation

This chapter summarizes and evaluates the results obtained from the experiment and the numerical model. Furthermore, the numerical modeling, the experiment and post-processing of data are presented and evaluated. The pros and cons regarding decisions made and how they may have impacted the final results are also discussed.

6.1 Results

6.1.1 Displacement

In table 5.1, mean displacement values are tabulated with respect to each individual sensor and configuration. Based on the table, one is able to investigate the tendency of displacements considering the different configurations. All configurations were loaded to approximately 12 kN, except for Configuration 0. Configuration 0 was initially tested up to 12 kN, but as the base configuration was too flexible, all of the sensors exceeded their calibrated validity zones. The loading was therefore limited to 6 kN in the remaining two series to ensure readable sensor data. Consequently, the displacement values for this configuration should be multiplied by a factor of two when compared to the others. By doing so, the displacement values for Configuration 0, is not surprisingly, far higher than for any of the other configurations. Without the panel, there is nothing but the slab elements connecting the three columns. A perfect rigid column floor connection, in the transverse direction to the MRF, would result in almost equal displacement values for the sensors located in the same plane, i.e sensors 2, 5 and 7. As seen from table 5.1, this is not the case, which corresponds well to the anticipated behavior of how the connection would behave. This is also taken into account when modeling the connection. The first test that was executed with the panel is represented by Configuration 1, where screws were inserted in the top and bottom of the CLT panel, illustrated in figure 3.28. When the panel is erected to the columns, a shift in displacement pattern is observed with a tighter correlation between the measured sensor-values for each plane. This can be illustrated with a standard deviation of 0,05 mm and 0,19 mm for middle and top plane, respectively.

In Configuration 2, additional rows of screws were inserted into the columns, consequently increasing the stiffness contribution from the CLT panel. The increased stiffness provided in Configuration 2, resulted in a lower displacement in all of the sensors, with the exception of sensor 3. As stated earlier, motivation for testing multiple configurations was to observe a point of convergence with respect to displacements. Based on the preparatory work done in Chapter 3, illustrated in Figure 3.22, there were strong indications that convergence would be reached for a given number of fasteners. The "point of convergence" is reached in Configuration 3, where the change in displacement from Configuration 3 to 4 and 5, are almost indistinguishable. From Configuration 6 to 9 - fasteners are systematically removed, withdrawing screws furthest from the center line of the CLT. This had a considerable effect on the overall stiffness of the system, represented by the increased displacement on every sensor. The relative change in displacement for the aforementioned configurations are tabulated in 6.1, where displacements are mean values for sensor 2, 5 and 8. For the last configuration, only screws about the center line were kept inserted. For this configuration, only a fraction of the stiffness potential of the shear wall is utilized. In fact, due to the location of the screws oriented about the center line of the panel, the stiffness contribution from the panel may be broken down to a beam element, with the ability to solely transfer load horizontally. This allows for significant displacements in the system.

Number of configuration	**Configuration n**	**Configuration n - 1**	**(ΔU)**
n = 5	2,33	-	-
n = 6	2,61	2,33	12%
n = 7	3,07	2,61	17,8%
n = 8	4,37	3,07	42,2%
n = 9	12,855	4,37	294,4%

Table 6.1: Relative displacements

Table 6.1, together with figure 5.14, emphasise the effect the location of the fasteners has on the system's stiffness, where the fasteners located with the highest distance from the midsection of the CLT contributes most to global stiffness. This correlation, between fastener position and contribution to the overall stiffness, is anchored in Steiner's Theorem.

The ISO-curve depicted in figure 6.2, is used as a benchmark on a structure's suitability as an office - or residential building. By increasing the stiffness, while keeping mass and damping constant, it will improve the capability of the structure by moving down and to the right in the diagram.

According to Eurocode 5 there exist no upper limit, in terms of horizontal displacement for a buildings' top floor, yet there is requested for each project to set its own reasonable limit. For WoodSol, the limit is in the range of $\frac{H}{500} < \delta_H < \frac{H}{300}$, where H is total height of the building.

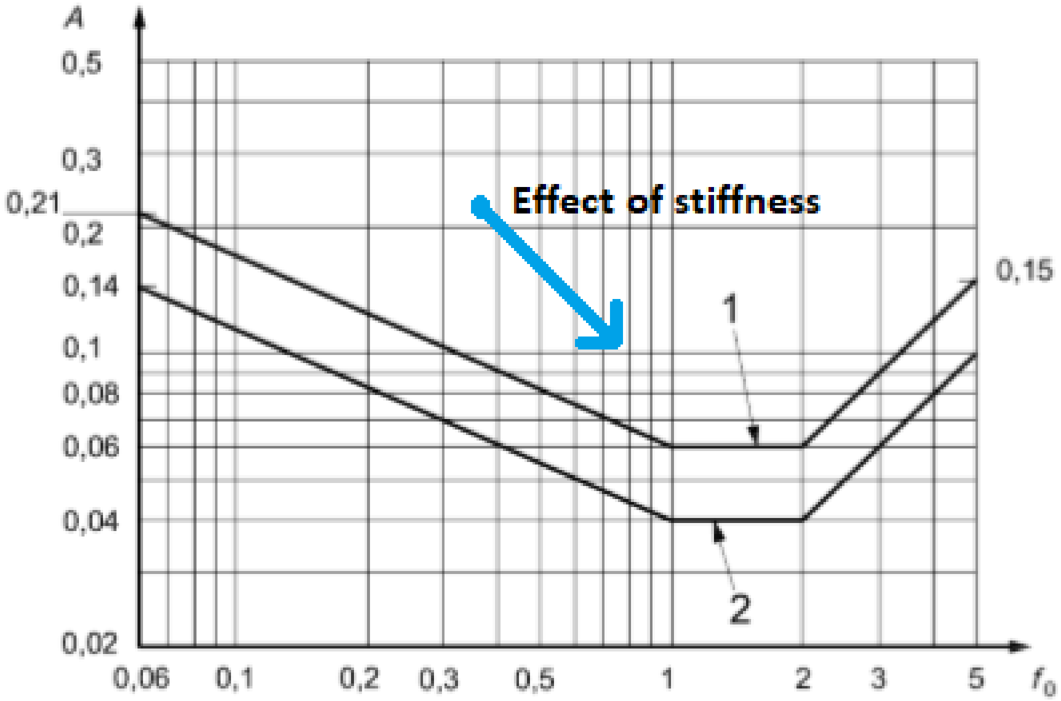


Figure 6.1: ISO curve illustrating the effect of increased stiffness

6.1.2 Dynamics

Predicting a reasonably damping coefficient for a large structure requires an impractical large amount of parameters to be evaluated. As theory suggests, an increase in structural components leads to an increase in mechanisms that contributes to the dissipation of energy. This often leads to engineers being very conservative in their analysis, and a value of ζ_{eq} for timber structures are commonly set to 1,5%. However, the damping of a structure might be a critical factor in the serviceability state of a building. An increase of as little as 0,4% was shown in the thesis of William Espeland [4], to potentially decrease the acceleration in an analysis of a large scale timber building from $0,075 m/s^2$ to $0,067 m/s^2$.

In a more visualized manner, we can correlate an increase in damping to a direct improvement towards the ISO 10137 criteria by moving straight down on the figure, as shown by Figure 6.2.

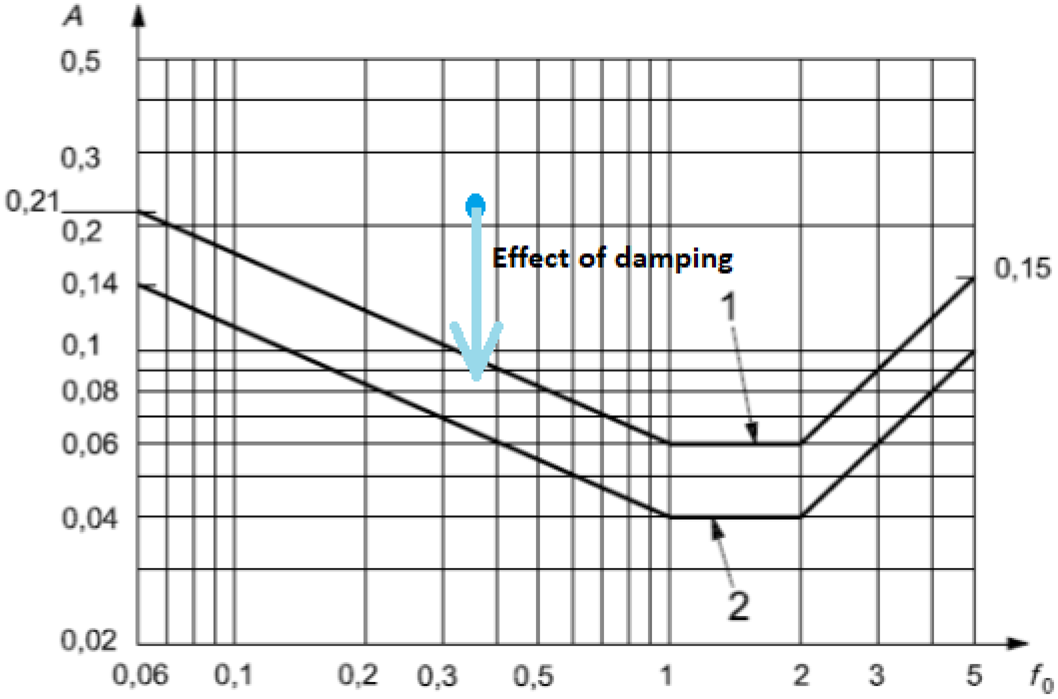


Figure 6.2: The effect of damping with relation to the comfort criteria in ISO 10137

During the experiments on the mock-up at Charlottenlund, a clear trend of an increase in system damping can be seen from configuration 0-5, see Table 5.3. The lowest damping observed is around 1,8%, while the highest is 2,6% if we exclude Configuration 9 at 3,28% as an extraneous value. This indicates that the number- and positioning of fasteners can result in a difference of 0,8% in damping of the system. Naturally one would assume that Configuration 5, where all of the fasteners are inserted, will have the highest effect on the damping, as there are more components that cause energy to be dissipated. This assumption derived from the theory seems to correlate well with the experimental data. When the number of fasteners decline, i.e from Configuration 6-9, an immediate drop is registered, before it increases to almost the same value as prior to the erection of the shear wall.

The greatest increase of 0,8%, does not naturally translate into an equivalent increase in a large scale timber building. However, it gives insight into quite an interesting situation that may arise when designing a construction that will use this bracing solution. In this thesis, it is registered that an increase in fasteners after Configuration 1, i.e 10 pairs of screws fastened with a large distance to the neutral axis of the CLT, had a negligible contribution to the displacement of the system. Therefore, from a displacement perspective, it would be of no value to increase the number of fasteners beyond those in Configuration 1. However, from a damping perspective using the maximum number of fasteners allowed will have a positive effect that might be just enough to get a structure under the ISO 10137 criteria.

By studying Table 5.4, i.e the dissipated energy of all sensors in all configurations, there is a challenge to really deduce anything related to the pointwise damping in the system. One of the major drawbacks of applying load in a single point during testing is the uncertainty in how the force propagates into the system. As static energy in each sensor point is a product of both force and displacement registered, the sensors believe they all are applied with the same force registered in the load cell. Thus, all of the dissipated values presented in Table 5.4 are just factored numbers of reality. Assumptions of how much force each sensor would have experienced in reality is debatable. Some calculations were performed, where $\frac{Forceapplied}{9}$ in each sensor and $\frac{Forceapplied}{3}$ in each column were assumed. The development and trends with these assumptions were similar to the ones presented in Table 5.4. It was decided to discard every assumption regarding the force distribution due to the uncertainties they introduced, rather than improving the accuracy of the results.

As explained, Table 5.4 gives some information on the contribution to energy dissipation for each location in the system. For instance, in configuration 0 and 9 there is a larger spread in the dissipated energy in the differing sensor locations. In configuration 5 it seems this spread is drastically decreased, and a more homogeneous level of energy dissipation is seen in all of the monitored locations. The exact reason for why such a high value for configuration 9 was obtained, is unclear. One of the reasons may be due to the nature of how the load was applied. The loading was done with a hand pulley, making the dissipated energy somewhat challenging to calculate. Many of the loading cycles are unevenly applied, which might be because of the varying pace during loading and unloading. A good illustration of this can be seen on the left side of Figure 5.20, where it was challenging to determine the exact boundaries of the enclosed area.

6.1.3 Numerical results

Table 5.6 shows, the initial model in SAP2000 based on recommendations and previous findings was off by 0,63- 15,08 mm in standard deviation for the averaged displacement of all sensors. The initial thought is that the results are accurate enough, but to assure that the model would predict the behavior of the frame for the most likely used configurations, the deformations were forced closer to the experimental values by changing the stiffness of the screws. Recommendations for axial stiffness, Equation 2.11 by Rothoblass, and the slip- modules by EC5, Equation 2.7, were kept constant to the greatest extent possible, while the rotational stiffness of the screws were adjusted. Given that the connections are modeled as fixed by default, conservative values were used to prevent overly stiff behavior of the system. The final and proposed stiffness could easily be converted to an average value per meter, hence used in similar analysis for those interested.

Modification 1 are within range of what the authors anticipated during the fastener study introduced in Section 3.4. The importance of lever arms are clearly illustrated by the comparison. The model is however sensitive to change in fastener inclination. As the model is built and calibrated upon results based on 30 deg. inclination, a noticeable difference can be seen on *Modification 2* where the screws are modeled without an inclination. One would expect higher deformations at every sensor position due to the absence of axial resistance against the applied force direction.

The general behavior is however favorable throughout the system with an average reduction of around 16 % in displacement. The root cause in the misinterpreted behavior is hard to explain, but a possible explanation could be the decomposition of rotational stiffness between the local and global coordinate system in the software. This means that all variations of inclination from 30 towards 0 deg. could lead to a decrease in deformation due to an overall increase in stiffness for all screws.

The modal analysis verifies the theory presented in Section 2.4, which states that the fundamental frequency of the model rises in line with increased stiffness. The system reaches its peak frequency for all modal shapes in Configuration 5 where all screws are installed. Figure 5.23 clearly illustrates this and the trend is transferable to all of the modes investigated. Configuration 9 stands out with the lowest fundamental frequency and the model behaves even more flexible than the base system. The placement of screws in this configuration are the least favorable in terms of added stiffness to the overall system. The contribution of the CLT panel is then governed by its weight, rather than its stiffness due to the poor utilization of the screws. This coincide with the fundamental frequency equation , $\omega_n = \sqrt{\frac{k}{m}}$, presented in Section 2.4.

6.2 Evaluation of methods

This section evaluates the use of modeling techniques, experiences from the experimental work and the process of post-processing experimental results.

6.2.1 Modelling

There is no exact blueprint for modeling a physical problem in a computer program. There are however well established techniques and proposed solutions which prevails uncertainties and gives more credible results. The models used in this thesis are built upon recommendations from supervisors, findings in previous theses and work from other research institutions. As one of the objectives of this thesis was to develop a model that included both the CLT component and geometric characteristics of a screw, the basis for comparison became a troublesome process. There are few, if any, comparable studies or results available, that investigate the same physical problem encountered in this thesis. This made the process of modeling time consuming, as it was desired to model correctly down to last detail. Further into the work, the focus shifted towards a model that represented the structural components and their behavior well enough from a global perspective.

In the post-calibration, all of the values that were "optimized" were adjusted manually. The underlying potential on some of the stiffness parameters was, therefore, left undiscovered to some extent. Perhaps a better approach, but more time consuming, would be to run a parametric optimization through a program such as ISIGHT or similar. In such a program, reasonable upper and lower limits are set for all parameters and the program will then run numerous combinations which will optimize the given problem. This would, for a full 3D model, be a considerable amount of work but could ultimately give more controlled and accurate results.

To be able to model the mock-up at Charlottenlund within the time limits that were available, certain assumptions had to be made. It was outside the range of this thesis to verify the techniques and stiffness used for modeling both the composite slab element and column-slab connector. Therefore it was assumed that these were thoroughly tested, verified and that the results were dependable. Furthermore, the only parameter that was tweaked to calibrate the model, after the experiment, was the stiffness of the fasteners. These values were considered more uncertain compared to the ones describing the CLT panel. The panel was assumed to be accurately represented by its values and needed minuscule changes at most. At first, a small scale experiment was planned that would enable the authors to model the fasteners in more detail. Due to time restrictions this was not possible, and the basis of the decision to only hold the fastener as the only changeable parameter was kept unchanged.

As highlighted in Section 6.1.3, the fasteners should have been modeled differently to make them less sensitive to change in inclination. With 3 individual springs for both the translation and the rotational stiffness parameters of each screw, the user would have more control over their behavior in the model.

6.2.2 Experimental work

For the writers of this thesis, this was the first experience of planning and executing an experiment. In the aftermath, many questions have been raised about whether some of the decisions made could have been done differently and how they may have impacted the final results. This section lists the parameters, which from the perspective of the authors, had the greatest influence on the final results.

Positioning and number of sensors

Determining the number, type and location of sensors to be used in the experiment, were based on a few factors. The number and type of sensors were mostly limited by the available equipment from the laboratory at the Department of Structural Engineering. A total of 10 sensors were used, split equal in numbers with 4 mm and 50 mm as validity ranges. 50 mm would have been preferable to be used for all sensors, as "out of boundary" values affected some of the final results.

The position of the sensors was chosen based on the idea of obtaining as much information as possible on how the CLT wall would affect the horizontal stability. A qualified guess of where the highest displacement values would occur was the main decision factor for the location of the sensors with the largest measuring range, i.e sensor 2-3-5-6-10 The most sensitive sensors were placed at the remaining positions. In hindsight, it was a mistake to place one of the better sensors at location 10, the midpoint of the slab, as it would have served a better purpose at sensor position 8 or 9.

Load procedure

During experimental planning, a lot of time was spent trying to determine a loading method that would yield the best results. The perfect loading procedure would have been a mechanically controlled tension and compression force, applied at a constant pace. However, due to the lack of equipment, the scale of the mock-up and the height of the designated load area, there was no obvious solution on how to apply the desired load. Based on the limitations presented, the solution was a tension force applied with a hand pulley. This solution also introduced a couple of problems. Using the hand pulley, it was difficult to keep the level of consistency with regard to pacing. The results clearly show these inconsistencies with the registered minimum and maximum values and the varying duration of each loading cycle.

The magnitude of the load, 12 kN, was chosen based on discussions with supervisor, Kjell Arne Malo. Therefore, no calculations of capacity were undergone prior to testing. How much the applied load may have caused permanent deformations to the system between each cycle is hard to pinpoint exactly. But through re-calibration of sensors, there were noticeable deformations, at least in sensors monitoring the loaded column. All sensors had to be "zeroed out" prior to the next series of cycles. If this was due to repetitive extensive loading, too high load or other unforeseen factors is hard to tell.

Data collection

During the first part of the experiment, data collection from all sensors were done at 10 Hz, i.e 10 measurements per second. It was not until configuration 2 that the frequency was increased to 50 Hz. The increase was recommended by one of the supervisors due to the inconsistency in the loading pace and some noticeable events of abrupt readings from the load cell, as illustrated in Figure 5.21. The low frequency for Configuration 1 doesn't necessarily effect the reliability of the data, but it should be taken into account for anyone using the raw data obtained from the experiment.

Instrumentation

In Appendix C the range of validity for each sensor is presented. For example sensor 7, with NKT number 264, has a validity range of ±2 mm. This means that the sensor has been calibrated, and can accurately monitor displacements between -2 mm and +2 mm from a load varying between compression and tension. It is however possible to achieve an effective range of 4 mm by "zero- balancing" the sensor at -2 mm and only apply one type of loading, in our case tension. It requires precision when positioning and readjusting the sensors prior to every new cycle performed. These steps have been performed to the best ability of the writers, however, it should be kept in mind that some inconsistencies may be found here, e.g "zero balanced" at -1,7 mm or -1,9 mm.

It should also be noted that even though the sensors are only calibrated for its respective validity zone, they are able to measure outside this range. One of these out bounds measurement can be seen on sensor 9 in Configuration 9, where a maximum displacement of 5,80 mm was registered. The accuracy of the measured value cannot be guaranteed beyond 4 mm, and should be used with this in mind. In Configuration 1, sensor-data was not able to be retrieved for sensors 1, 4 and 7. This was due to an error in the connection of the measurement/amplifier module. The error was fixed before tests on Configuration 2, but was not discovered until the post-processing of data began. Therefore the values for sensors 1, 4 and 7 are set to "Not Any Number" in Figure 5.4, or NaN for short.

Fasteners

The decision to divide the number of fasteners into configurations, was something that was planned on short notice. In hindsight, the fasteners should have been spread out evenly along the whole height of the CLT panel and assigned to configurations respectively. This would, however, lead to practical implications which would extend the duration of the experimental testing considerably. An even distribution of the fasteners would make quantification of the data into stiffness per length, or similar, much easier. By having stiffness defined per length, the screws could be modeled as a weightless shell- elements between the CLT and column, which is far less time consuming than linked elements. The properties of the shell element, i.e e-modules, could then be easily changed through material descriptions.

Configuration 1 is considered the most effective with respect to the numbers of screws used. The positioning of the screws are not surprisingly the most optimal and only minor decreases in the horizontal displacement were registered up towards configuration 5. An alternative approach would be to start from a more flexible layout and increase the stiffness as a combined product of both the number of screws and their position.

As some of the screws were inserted through multiple configurations, some local relaxation and compression in the wood surrounding the screws is expected to happen. These phenomenons are theoretically influencing the slip-module of the connector to some extent, but as no attempt has been made to measure or calculate these effects, they are not devoted any others thoughts than described here.

Moisture content

It is well known that wood is a hygroscopic material, which describe its ability to absorb and retain water. Consequently, the material will adapt to the conditions of its surroundings, which are dependent on moisture and temperature. The moisture content in wood greatly affects the material parameters in line with the ratio between fiber-material and water per mm^3, i.e swelling and shrinkage. To keep a level of consistency, wood components used in experiments should be controlled and preferably be placed in climate controlled rooms prior to testing. As previously stated, the mock-up was located in the workshop at Charlottenlund Vgs, where a climate controlled environment was impossible to obtain. Moisture content was not controlled prior to or during testing on either of the components. This may have impacted the results to some degree, because some of the material properties, at least for the CLT, may have deviated from the actual values. The experiment lasted for a total of two weeks and during this time the CLT element might have shrunk, such that the friction between the column and CLT could have been reduced to some extent.

6.2.3 Post processing of data

The experiment was conducted with a total of 10 different configurations. For each configuration, there were 10 sensors tracking the horizontal displacement at different locations. Each sensor registered displacement at 10 Hz and 50 Hz in 2 and 8 configurations, respectively. A total of 3 series was performed for each configuration and the applied load was also measured at the same sampling rate.

The average number of registered data points is around 20 000 per sensor, for each series. This means that the total number of data collected in the experiment is approximately: $10_{configurations} \cdot 3_{series} \cdot 10_{sensors} \cdot 20.000_{values} = 6.000.000$ individual values. Post processing this amount of data has proven to be quite hard with respect to the time available. The post-processing of data was done in Visual Basic and Matlab. The main goal of using two independent programs was to:

1. process the data.
2. control that the processed data was credible and comparable to each other.

To ensure reliable data it was important to run scripts in both VBA and Matlab, since they rely on different algorithms. VBA was used as a basis, with an effective code with low computational time, while Matlab was used for cross-checking and visualizing some of the extracted data. Cross-checking was performed whenever the processed data from VBA showed significant inconsistency. A typical loading cycle, which is based on an arbitrary series in two different configurations, is illustrated in Figure 6.3.

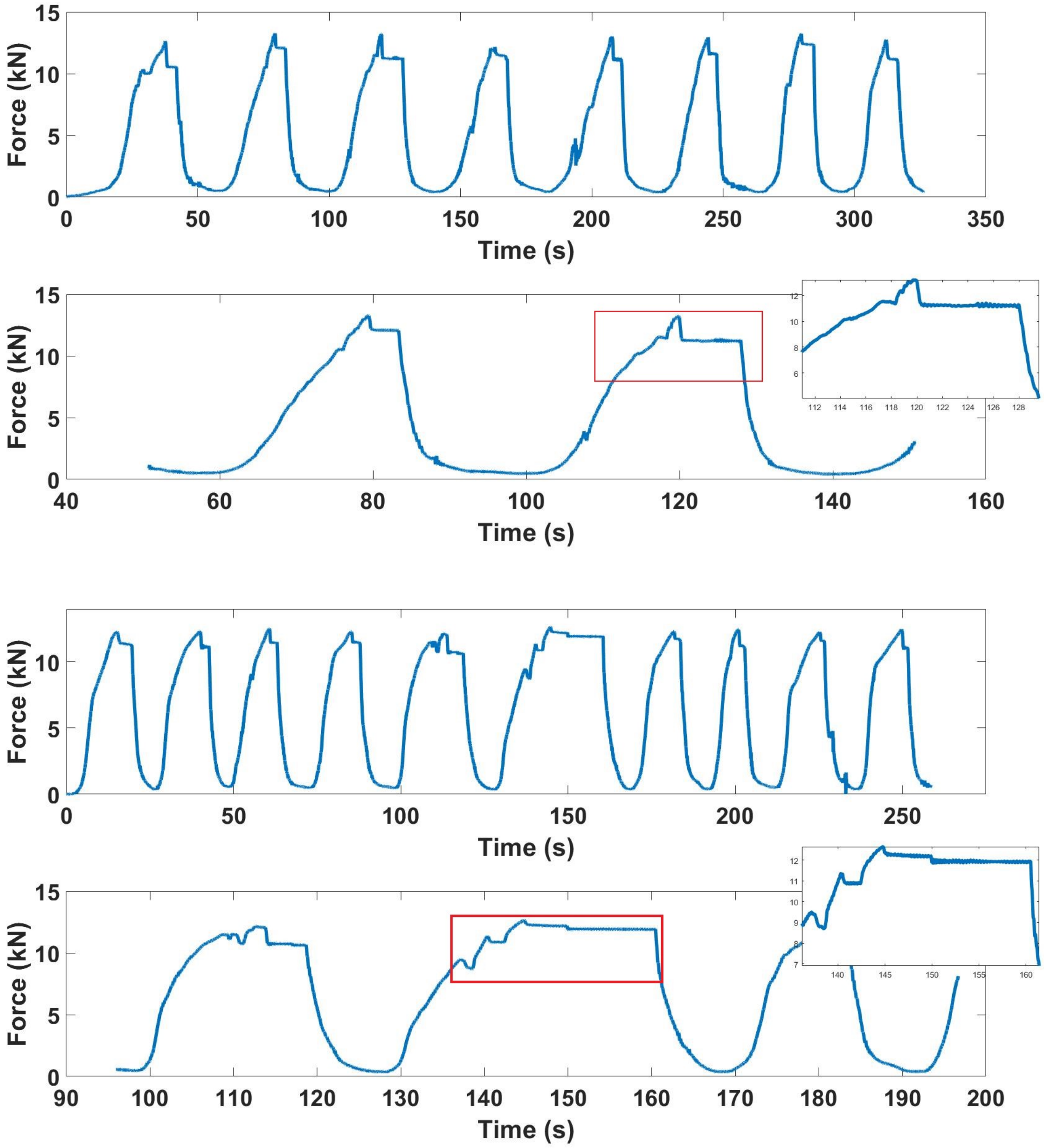


Figure 6.3: Force-Time cycles for Configuration 4 and 9, respectively.

An in-depth analysis of the cycle shows that there are many local minimum and maximum values. This makes it difficult to create a script that can find the correct point where the loading ends and the unloading begins, and vice versa. With this in mind, some of the data presented might have been created with some minor flaws, despite that the control script was created.

None of the authors have any experience with analyzing big data and the work was done to the best of their ability. There might be better, more correct or more interesting ways to analyze the data, and therefore the full set of raw data with scripts can be made available on request.

Chapter 7

Conclusion and further work

7.1 Conclusion

To better understand the stabilizing effect a CLT panel can have when mounted to the exterior face of columns, it is essential to understand and anticipate how much of its potential can be utilized. The inner resistance can never be taken advantage of if the fastener solution is inapplicable or poorly designed. Naturally, a considerable part of this study was focused on how screws influenced the behavior of the structural system.

A total of 9 layout designs for screws were tested, with the goal of getting a better understanding of how the effectiveness of the wall varies by the position and number of screws used. A variation of 20-90 screws were installed with a 30 degree (±5%) inclination in each column, leading to a total of 270 screws used in the "final" configuration (Configuration 5). Reasonable results were obtained by varying the number of screws while the inclination, diameter and length were kept constant throughout the experiment.

All configurations showed promising results concerning the displacement of the system. With an average reduction of between 39,4-91,3 % in displacement at the top of the loaded column (location of sensor 3), the CLT panel demonstrated how effective it can be when fastened properly. The effectiveness of the different configurations did however converge towards the smallest displacement faster than anticipated. The authors were made aware of this during experimental testing, as the following configurations, after Configuration 2, gave minuscule change in the displacement compared to the previously tested. The importance of the positioning of the screws became obvious when Configuration 6-9 were tested as the overall displacement rapidly increased from 4,7 mm to 27,6 mm.

The small differences in the displacement results, seen between configurations 2 to 5, became more meaningful viewed from a dynamic standpoint. With a steady increase from 1,88 % towards 2,60 % in equivalent viscous damping, it became evident that every pair of screws installed between Configuration 1-5 led to valuable results. Although the calculations for the damping is based on an assumption which is not presented in dynamic theory, the results seem credible and fall into the range of 1,5 - 4,0 %, which was expected prior to experimental testing. As a supplement to the experimental results, the updated numerical model provided some additional information about the dynamic properties of the system. The overall trend in the development of the natural frequency is seen through all of the modes presented. As the modes are represented as well separated frequencies (e.g. 3,17-4,48-7,46 Hz), i.e spaced sufficiently, there seems to be little chance that they will interfere and cause disturbance.

The numerical model, with its updated components, has provided accurate results with a standard deviation between 0,33 - 1,86 mm for the averaged displacement of the nine sensors. Other combinations of screw configurations have also proven to be within the predicted range. The final result is therefore believed to give fairly good estimates on how the system would behave in reality and its characteristics could be implemented into larger projects. The model is however sensitive to change in inclination, and it is not recommended to rely heavily on the results if a change in inclination is performed.

Overall it can be said that the effect of a CLT element fastened to the outside with screws on the exterior side of a moment resisting frame, is very promising. A total reduction of 91,3 % in the displacement was possible, and a total equivalent viscous damping of 2,6 % was measured. To be considered an acceptable solution, the frame had to satisfy the requirement of $\delta_H \leqslant \frac{H_{story}}{500} - \frac{H_{story}}{1000}$ in horizontal displacement. This solution has proven to be well under these limitations, down to as much as $\delta_H \leqslant \frac{H_{story}}{1260}$. The considerable effect on damping proves to be quite useful when trying to fulfill the ISO 10137 recommendations for accelerations. With experience from experimental testing and a practical standpoint, the CLT panel fastened with screws has proven to be a practical and efficient solution.

7.2 Recommendations for further work

As this thesis clarifies, the key component to utilize the stiffness of a CLT panel in a structural system is the users choice in fastener solution. Fully threaded screws with inclination are one of many solutions that can give satisfactory results with limited effort in installment. One of the major issues are however, the uncertainties with regard to the stiffness of the screws when they are installed with an inclination.

A smaller test was planned during this thesis to better understand and predict the behavior of the screws. The motivation behind the test was to find its stiffness values and apply it to the full-scale model of the mock-up. A smaller 3D-model was created with the characteristics from the CLT panel and the glulam used in the experiment. An experiment was planned, with a cyclic load F acting upon the top of the CLT. The panel was to be fastened with two pair of screws into the "glulam-column", with the same layout as in the main experiment. Dimensions and a proposed layout of the test can be seen in Figure 7.1. A total of 8 panels were planned to be tested.

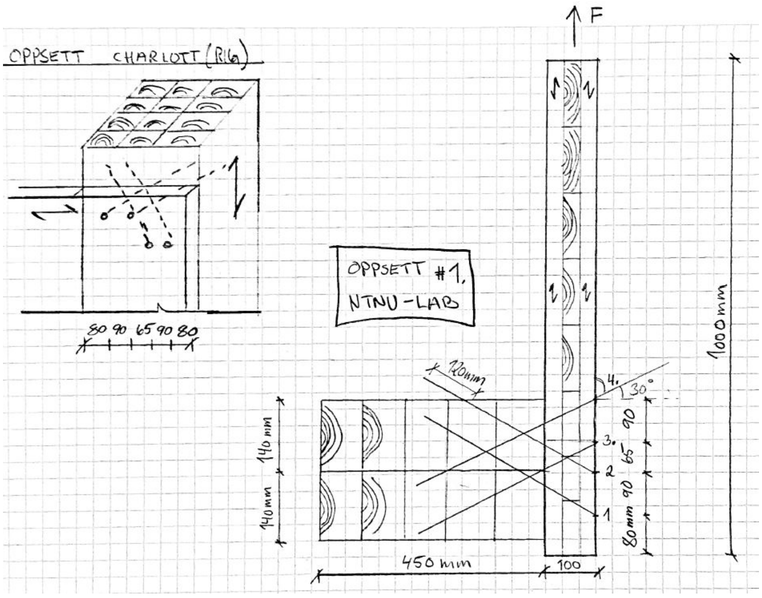


Figure 7.1: Sketch of smaller experiment

This test is strongly recommended to be carried out. Not only will it lead to a better understanding of the screws itself, but the information will minimize the uncertainties when the concept of exterior fastened panels are adapted and modeled into a larger building.

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Appendix A

Stiffness matrix

Buildup	D_{11}	D_{12}	D_{22}	D_{33}	D_{44}	D_{55}	D_{66}	D_{67}	D_{77}	D_{88}
40-20-40	1075	19	69	37	12741	9733	1040000	15287	140000	51520

For simplicity, set D_{12} and D_{67} to zero.

Flexural

$$D_{11} = E_{o,mean} \cdot I_{0,net}$$

$$D_{12} = \sum_{n=1}^{n} \frac{t_i^3}{12} \cdot d_{12,i}$$

$$D_{22} = E_{o,mean} \cdot I_{90,net}$$

$$D_{33} = K_{twist} \cdot G_{0,mean} \cdot \frac{b \cdot d^3}{12}$$

Shear

$$D_{44} = \kappa_x \cdot \sum G_{i,x} \cdot t_i$$

$$D_{55} = \kappa_y \cdot \sum G_{i,y} \cdot t_i$$

Axial

$$D_{66} = \sum_{n=1}^{n} h_{i,0,net} \cdot E_{0,mean}$$

$$D_{67} = \sum_{n=1}^{n} t_i * d_{12,i}$$

$$D_{77} = \sum_{n=1}^{n} h_{i,90,net} \cdot E_{90,mean}$$

$$D_{88} = G_{0,mean} \cdot d \cdot K_{shear}$$

K$_{shear} = 0,70, K_{twist} = 0,65, K_x = 0,194, K_y = 0,637$

Appendix B

Calculations of slab-column connection

$$U1 = \frac{(\text{ Two sides of bracket}) * (\text{ Two rods}) * R3}{z^2}$$

$$U1 = \frac{2 * 2 * 5000000000}{400^2} = 125000 \qquad (N/mm)$$

$$U2 = U1/10$$

$$U2 = 125000/10 = 12500 \qquad (N/mm)$$

$$U3_{slab} = U3_{column} = \frac{(\#\text{ rods}) * (\text{steel-to-timber connection}) * \rho_m^{1.5} * d_{eff}}{23}$$

where:

d_{eff} $= 1.1 * d_{in}$

$$U3_{slab} = U3_{column} = \frac{8 * 2 * 430^{1.5} * (1.1 * 16)}{23} = 109000 \qquad (N/mm)$$

$$U3_{total} = \frac{U3_{slab} * U3_{column}}{U3_{slab} + U3_{column}}$$

$$U3_{total} = \frac{109000 * 109000}{109000 + 109000} = 54600 \qquad (N/mm)$$

$$R1 = \frac{U3 * 0,70 * z^2}{4}$$

where:

z = is the distance between top and bottom rods

$$R1 = \frac{54600 * 0,70 * 400^2}{4} \approx 150000000 \qquad (Nmm)$$

$$R2 = \frac{K1}{4}\frac{(z_1^2 + z_2^2)}{2}$$

where:

$z_1 and z_2$ = are the distances between the in-plane rods

$$R2 = \frac{125000}{4}\frac{(130^2 + 210^2)}{2} \approx 950000000 \qquad (Nmm)$$

Appendix C

$SensorID$	$Validityrange[mm]$	NKT nr	Modell	F.nr	$Type^*$	$Sensitivity[mV/V]$
1	±2	263	WA/2 mm	130810226	IH	80
2	0-50	250	WA50	210310030	IH	80
3	0-50	253	WA50	210310032	IH	80
4	±2	281	WA/2 mm	191010394	IH	80
5	0-50	267	WA50	161210364	IH	80
6	0-50	256	WA50	161210362	IH	80
7	±2	264	WA/2 mm	130810225	IH	80
8	±2	267	WA/2 mm	130810222	IH	80
9	±2	265	WA/2 mm	124810229	IH	80
10	0-50	252	WA50	210310031	IH	80

LVDT sensor data

* inductive halfbridge

Appendix D

In this appendix, all acquired data from the experimental work are tabulated and systematically organized. All tables have the same structure, and each table is labeled in the top left corner. All configurations, except for Configuration 0, consists of six tables, implying that every series is separated in two, i.e. Table A and Table B. Table A contains the loading and unloading for the first four cycles, while Table B holds values for Cycle 5 to 8. Loading of the system is naturally restricted to the odd numbers in the first row of each table, while even numbers are related to unloading. In each of the loading/unloading sequences, the corresponding force- , displacement - and compliance values are presented. The compliance values, also referred to as flexibility, are calculated based on a regression line of 1st order, where the gradient of the line is inverted. Furthermore, a *Compliance_Cycle* is calculated as an average of the associated compliance values. For each cycle, *Static Energy* and *Energy Dissipation* are calculated. For each hysteresis loop *Static Energy* is based on the characteristics of the cycle. The *Static energy* is obtained by calculating the area below the gradient line, which is determined from *Fmax* and *Fmin.* Finally the *Energy Dissipation* is found through the enclosed area for each hysteresis loop.

For the sensors marked with *, the validity range has been exceeded.

Config 0 Series 1 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.66	0.66	0.68	0.68	0.66	0.66	0.68
	Fmax	6.07	6.07	6.04	6.04	6.14	6.14	6.11	6.11
Sensor 1	Umin	-0.005	0.422	0.338	0.436	0.294	0.454	0.318	0.427
	Umax	1.652	1.652	1.649	1.646	1.662	1.662	1.655	1.655
	Compliance	0.295	0.268	0.248	0.264	0.255	0.276	0.247	0.265
	Compliance_Cycle	0.281		0.256		0.265		0.255	
	Static Energy	4.068		3.919		3.957		3.964	
	Energy Dissipation	1.617		1.290		1.330		1.241	
Sensor 2	Umin	-0.040	4.885	3.921	4.984	3.467	5.139	3.727	4.936
	Umax	20.600	20.330	20.190	20.090	20.270	20.170	20.210	20.160
	Compliance	3.610	3.261	3.061	3.251	3.113	3.343	3.048	3.220
	Compliance_Cycle	3.427		3.153		3.224		3.131	
	Static Energy	57.876		52.279		48.887		49.253	
	Energy Dissipation	12.631		12.660		12.660		12.420	
Sensor 3	Umin	-0.086	11.030	8.653	11.430	7.862	11.690	8.331	11.300
	Umax	44.730	44.730	44.720	44.720	44.710	44.710	44.710	44.710
	Compliance	7.890	7.217	6.835	7.253	6.947	7.441	6.794	7.165
	Compliance_Cycle	7.539		7.038		7.186		6.975	
	Static Energy	112.072		107.188		106.264		107.098	
	Energy Dissipation	30.118		29.118		29.118		28.281	
Sensor 4	Umin	0.000	0.269	0.226	0.353	0.280	0.433	0.365	0.486
	Umax	1.096	1.090	1.148	1.138	1.222	1.211	1.287	1.281
	Compliance	0.187	0.177	0.171	0.170	0.170	0.174	0.167	0.168
	Compliance_Cycle	0.182		0.170		0.172		0.168	
	Static Energy	2.809		2.713		2.709		2.714	
	Energy Dissipation	1.061		0.919		0.937		0.912	
Sensor 5	Umin	-0.027	1.779	1.390	1.939	1.270	2.044	1.407	1.967
	Umax	9.566	9.566	9.557	9.572	9.687	9.687	9.681	9.681
	Compliance	1.643	1.683	1.524	1.667	1.537	1.705	1.502	1.644
	Compliance_Cycle	1.663		1.593		1.616		1.570	
	Static Energy	25.467		24.946		24.944		25.037	
	Energy Dissipation	8.492		7.314		7.134		6.909	
Sensor 6	Umin	-0.105	0.639	-0.212	0.859	-0.465	0.901	-0.395	0.840
	Umax	16.290	16.290	16.300	16.440	16.710	16.640	16.460	16.510
	Compliance	2.701	3.410	3.031	3.408	3.066	3.500	2.975	3.352
	Compliance_Cycle	3.014		3.209		3.269		3.153	
	Static Energy	47.994		50.496		50.300		50.268	
	Energy Dissipation	16.356		15.328		15.328		15.169	
Sensor 7	Umin	-0.002	0.229	0.184	0.247	0.170	0.256	0.189	0.244
	Umax	1.199	1.191	1.203	1.190	1.212	1.194	1.209	1.200
	Compliance	0.206	0.204	0.189	0.204	0.189	0.208	0.186	0.201
	Compliance_Cycle	0.205		0.196		0.198		0.193	
	Static Energy	3.218		3.138		3.139		3.139	
	Energy Dissipation	0.947		0.754		0.740		0.708	
Sensor 8 *	Umin	-0.014	2.042	1.638	2.217	1.495	2.328	1.664	2.219
	Umax	6.219	6.219	6.216	6.227	6.185	6.185	6.115	6.167
	Compliance	1.259	1.228	0.958	1.163	0.986	1.247	0.916	1.168
	Compliance_Cycle	1.243		1.050		1.101		1.027	
	Static Energy	16.865		12.282		12.856		12.082	
	Energy Dissipation	5.345		3.527		3.301		2.953	
Sensor 9 *	Umin	0.001	1.363	0.461	1.439	0.368	1.691	0.955	1.737
	Umax	4.721	4.760	4.727	4.758	4.754	4.754	4.706	4.760
	Compliance	0.952	1.026	0.907	1.003	0.933	1.119	0.770	1.070
	Compliance_Cycle	0.988		0.953		1.018		0.896	
	Static Energy	14.323		11.485		11.990		10.214	
	Energy Dissipation	2.850		3.205		2.858		2.384	
Sensor 10	Umin	-0.003	1.662	1.348	1.761	1.260	1.834	1.363	1.737
	Umax	7.559	7.559	7.632	7.605	7.689	7.638	7.656	7.656
	Compliance	1.309	1.280	1.172	1.282	1.183	1.311	1.156	1.268
	Compliance_Cycle	1.294		1.225		1.244		1.209	
	Static Energy	19.707		19.178		19.065		19.026	
	Energy Dissipation	6.859		5.153		5.025		4.879	

Config 0 Series 1 Table B	**Loading / Unloading**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
	Fmin	0.68	0.66	0.66	0.69	0.69	0.67	0.67	0.66
	Fmax	6.18	6.18	6.11	6.11	6.08	6.08	5.99	5.99
Sensor 1	**Umin**	0.295	0.419	0.304	0.433	0.302	0.429	0.279	0.421
	Umax	1.668	1.657	1.656	1.653	1.649	1.648	1.634	1.634
	Compliance	0.252	0.260	0.250	0.259	0.247	0.264	0.252	0.266
	Compliance_Cycle	0.256		0.255		0.255		0.259	
	Static Energy	4.089		3.959		3.903		3.839	
	Energy Dissipation	1.296		1.268		1.241		1.230	
Sensor 2	**Umin**	3.479	4.867	3.518	5.071	3.584	5.054	3.373	4.999
	Umax	20.250	20.050	20.190	20.030	20.160	20.050	20.060	20.020
	Compliance	3.076	3.154	3.068	3.148	3.029	3.190	3.075	3.214
	Compliance_Cycle	3.115		3.108		3.107		3.143	
	Static Energy	50.149		49.094		48.446		47.861	
	Energy Dissipation	12.448		12.519		12.344		12.265	
Sensor 3	**Umin**	7.783	11.110	7.849	11.500	7.990	11.540	7.431	11.320
	Umax	44.700	44.700	44.690	44.690	44.680	44.680	44.670	44.670
	Compliance	6.831	7.048	6.872	7.046	6.773	7.124	6.903	7.190
	Compliance_Cycle	6.938		6.958		6.944		7.044	
	Static Energy	108.736		107.248		106.199		106.147	
	Energy Dissipation	27.804		28.368		27.981		27.983	
Sensor 4	**Umin**	0.418	0.551	0.490	0.623	0.557	0.692	0.614	0.757
	Umax	1.364	1.348	1.429	1.414	1.497	1.485	1.552	1.547
	Compliance	0.169	0.167	0.169	0.167	0.169	0.170	0.170	0.171
	Compliance_Cycle	0.168		0.168		0.169		0.170	
	Static Energy	2.791		2.721		2.694		2.628	
	Energy Dissipation	0.957		0.918		0.920		0.889	
Sensor 5	**Umin**	1.321	1.985	1.391	2.085	1.435	2.105	1.365	2.098
	Umax	9.717	9.691	9.663	9.663	9.654	9.654	9.594	9.595
	Compliance	1.520	1.622	1.507	1.620	1.489	1.633	1.508	1.637
	Compliance_Cycle	1.569		1.562		1.558		1.570	
	Static Energy	25.499		24.639		24.344		23.874	
	Energy Dissipation	7.113		6.998		6.848		6.759	
Sensor 6	**Umin**	-0.466	0.841	-0.463	0.916	-0.465	0.887	-0.465	0.782
	Umax	16.500	16.460	16.250	16.280	16.150	16.150	15.840	15.890
	Compliance	3.010	3.314	2.976	3.319	2.936	3.335	2.964	3.335
	Compliance_Cycle	3.155		3.138		3.123		3.138	
	Static Energy	51.082		49.169		48.581		47.381	
	Energy Dissipation	15.075		14.776		14.694		14.397	
Sensor 7	**Umin**	0.172	0.246	0.181	0.255	0.183	0.258	0.174	0.256
	Umax	1.220	1.196	1.211	1.190	1.210	1.192	1.199	1.192
	Compliance	0.188	0.199	0.186	0.198	0.185	0.200	0.187	0.201
	Compliance_Cycle	0.193		0.192		0.192		0.194	
	Static Energy	3.218		3.115		3.078		3.008	
	Energy Dissipation	0.742		0.735		0.719		0.708	
Sensor 8 *	**Umin**	1.536	2.232	1.608	2.292	1.635	2.344	1.554	2.330
	Umax	6.112	6.227	5.998	6.227	6.101	6.227	6.155	6.187
	Compliance	0.956	1.075	0.880	1.084	0.871	1.176	0.899	1.197
	Compliance_Cycle	1.012		0.971		1.000		1.027	
	Static Energy	12.577		11.958		12.037		12.244	
	Energy Dissipation	3.119		2.955		2.956		3.024	
Sensor 9 *	**Umin**	0.555	1.584	0.841	1.573	0.838	1.718	0.556	1.388
	Umax	4.494	4.751	4.659	4.760	4.623	4.718	4.289	4.621
	Compliance	0.792	1.011	0.755	1.049	0.745	1.124	0.720	1.171
	Compliance_Cycle	0.888		0.878		0.896		0.892	
	Static Energy	10.825		10.401		10.202		9.935	
	Energy Dissipation	1.681		1.920		1.859		1.689	
Sensor 10	**Umin**	1.278	1.753	1.335	1.797	1.344	1.834	1.297	1.833
	Umax	7.724	7.639	7.663	7.659	7.674	7.664	7.619	7.619
	Compliance	1.171	1.241	1.160	1.246	1.150	1.262	1.163	1.267
	Compliance_Cycle	1.205		1.202		1.203		1.213	
	Static Energy	19.516		18.791		17.013		16.691	
	Energy Dissipation	5.059		5.001		4.915		4.839	

Config 0 Series 2 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.62	0.62	0.61	0.61	0.63	0.63	0.67
	Fmax	6.07	6.07	6.11	6.11	6.11	6.11	6.12	6.12
Sensor 1	Umin	-0.002	0.445	0.323	0.448	0.310	0.463	0.344	0.494
	Umax	1.711	1.701	1.713	1.713	1.715	1.715	1.717	1.717
	Compliance	0.304	0.270	0.256	0.275	0.255	0.262	0.251	0.269
	Compliance_Cycle	0.286		0.265		0.259		0.260	
	Static Energy	4.181		4.041		4.004		3.984	
	Energy Dissipation	1.778		1.320		1.325		1.291	
Sensor 2	Umin	-0.059	4.884	3.438	4.923	3.360	5.083	3.718	5.436
	Umax	20.490	20.300	20.540	20.490	20.580	20.560	20.620	20.600
	Compliance	3.591	3.253	3.120	3.291	3.120	3.160	3.070	3.233
	Compliance_Cycle	3.414		3.203		3.140		3.149	
	Static Energy	51.247		50.043		49.681		49.498	
	Energy Dissipation	15.989		12.989		13.039		12.654	
Sensor 3	Umin	-0.246	10.970	7.248	11.090	7.059	11.240	7.860	12.050
	Umax	45.510	45.510	45.510	45.510	45.500	45.500	45.490	45.490
	Compliance	8.031	7.292	6.985	7.336	6.992	7.063	6.894	7.202
	Compliance_Cycle	7.644		7.156		7.027		7.045	
	Static Energy	113.431		110.626		109.692		108.967	
	Energy Dissipation	36.573		29.330		29.280		28.587	
Sensor 4	Umin	-0.004	0.272	0.214	0.326	0.259	0.391	0.335	0.457
	Umax	1.122	1.106	1.179	1.175	1.238	1.238	1.296	1.296
	Compliance	0.192	0.180	0.175	0.183	0.174	0.176	0.173	0.182
	Compliance_Cycle	0.186		0.179		0.175		0.177	
	Static Energy	2.845		2.807		2.794		2.790	
	Energy Dissipation	1.112		0.928		0.937		0.909	
Sensor 5	Umin	-0.041	1.656	1.046	1.657	1.013	1.777	1.227	1.911
	Umax	9.404	9.395	9.550	9.548	9.440	9.440	9.518	9.518
	Compliance	1.622	1.668	1.530	1.677	1.507	1.616	1.491	1.655
	Compliance_Cycle	1.645		1.600		1.560		1.569	
	Static Energy	24.592		25.154		24.694		24.642	
	Energy Dissipation	7.649		7.167		7.264		7.044	
Sensor 6	Umin	-0.057	1.505	0.034	1.385	-0.101	1.581	0.282	1.750
	Umax	17.440	17.340	17.750	17.740	17.070	17.110	17.230	17.240
	Compliance	2.946	3.428	3.094	3.440	3.018	3.317	2.988	3.396
	Compliance_Cycle	3.169		3.258		3.160		3.179	
	Static Energy	48.334		51.298		49.558		49.487	
	Energy Dissipation	14.893		15.857		16.106		15.490	
Sensor 7	Umin	-0.006	0.224	0.160	0.226	0.155	0.241	0.179	0.255
	Umax	1.206	1.181	1.211	1.199	1.214	1.206	1.216	1.213
	Compliance	0.207	0.204	0.189	0.206	0.188	0.199	0.186	0.204
	Compliance_Cycle	0.205		0.197		0.193		0.195	
	Static Energy	3.198		4.041		4.004		3.984	
	Energy Dissipation	0.913		0.732		0.739		0.725	
Sensor 8 *	Umin	-0.040	2.112	1.468	2.126	1.422	2.264	1.647	2.407
	Umax	6.188	6.207	6.187	6.187	6.137	6.230	6.158	6.230
	Compliance	1.296	1.188	0.947	1.237	0.996	1.106	0.877	1.141
	Compliance_Cycle	1.239		1.072		1.048		0.992	
	Static Energy	18.910		12.970		12.975		12.373	
	Energy Dissipation	5.020		3.075		3.166		2.934	
Sensor 9 *	Umin	-0.011	2.452	1.501	2.274	1.422	2.621	1.861	2.593
	Umax	6.060	6.137	6.005	6.161	6.033	6.160	5.818	6.079
	Compliance	1.337	1.215	0.899	1.351	0.943	1.179	0.742	1.214
	Compliance_Cycle	1.273		1.080		1.048		0.921	
	Static Energy	18.434		12.379		12.688		10.853	
	Energy Dissipation	4.204		2.124		2.641		1.869	
Sensor 10	Umin	-0.042	1.652	1.238	1.658	1.154	1.752	1.334	1.854
	Umax	7.656	7.556	7.674	7.671	7.688	7.688	7.701	7.701
	Compliance	1.326	1.270	1.179	1.290	1.172	1.242	1.156	1.276
	Compliance_Cycle	1.297		1.232		1.206		1.213	
	Static Energy	19.621		19.206		19.004		18.895	
	Energy Dissipation	6.560		5.008		5.060		4.918	

Config 0 Series 2 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.67	0.68	0.68	0.67	0.67	0.60	0.60	0.67
	Fmax	6.11	6.11	6.09	6.09	6.08	6.08	6.05	6.05
Sensor 1	Umin	0.352	0.509	0.363	0.504	0.342	0.465	0.337	0.507
	Umax	1.716	1.704	1.714	1.709	1.715	1.715	1.711	1.711
	Compliance	0.248	0.267	0.248	0.258	0.249	0.261	0.251	0.266
	Compliance_Cycle	0.257		0.253		0.255		0.258	
	Static Energy	3.898		3.907		3.946		3.922	
	Energy Dissipation	1.259		1.229		1.230		1.271	
Sensor 2	Umin	3.807	5.619	3.901	5.591	3.765	5.166	3.677	5.680
	Umax	20.610	20.390	20.600	20.430	20.620	20.620	20.610	20.610
	Compliance	3.041	3.227	3.040	3.113	3.051	3.142	3.060	3.215
	Compliance_Cycle	3.131		3.076		3.096		3.135	
	Static Energy	48.600		48.709		49.032		48.756	
	Energy Dissipation	12.373		12.260		12.569		12.311	
Sensor 3	Umin	8.088	12.510	8.271	12.340	7.839	11.320	7.585	12.610
	Umax	45.480	45.480	45.480	45.480	45.470	45.470	45.460	45.460
	Compliance	6.826	7.246	6.828	6.988	6.860	7.014	6.884	7.215
	Compliance_Cycle	7.030		6.907		6.936		7.046	
	Static Energy	107.063		107.520		108.437		108.194	
	Energy Dissipation	27.942		27.798		28.432		28.222	
Sensor 4	Umin	0.385	0.521	0.440	0.566	0.484	0.595	0.526	0.670
	Umax	1.350	1.331	1.400	1.388	1.452	1.452	1.498	1.498
	Compliance	0.173	0.181	0.173	0.176	0.173	0.179	0.174	0.182
	Compliance_Cycle	0.177		0.175		0.176		0.178	
	Static Energy	2.757		2.768		2.779		2.755	
	Energy Dissipation	0.910		0.893		0.879		0.904	
Sensor 5	Umin	1.253	2.005	1.318	2.025	1.245	1.865	1.215	2.074
	Umax	9.490	9.463	9.463	9.463	9.480	9.480	9.494	9.494
	Compliance	1.484	1.653	1.487	1.598	1.483	1.602	1.489	1.643
	Compliance_Cycle	1.564		1.541		1.541		1.562	
	Static Energy	24.175		24.104		24.213		24.126	
	Energy Dissipation	6.955		6.856		6.689		6.863	
Sensor 6	Umin	0.240	1.818	0.315	1.891	0.067	1.482	-0.030	1.790
	Umax	17.440	17.310	17.110	17.110	16.760	16.850	16.820	16.850
	Compliance	2.973	3.413	2.994	3.282	2.976	3.281	2.991	3.377
	Compliance_Cycle	3.178		3.131		3.121		3.172	
	Static Energy	49.369		48.688		48.371		48.368	
	Energy Dissipation	15.400		15.253		14.945		14.908	
Sensor 7	Umin	0.182	0.270	0.189	0.267	0.180	0.249	0.173	0.276
	Umax	1.218	1.192	1.216	1.193	1.217	1.216	1.214	1.213
	Compliance	0.186	0.202	0.186	0.197	0.186	0.198	0.186	0.202
	Compliance_Cycle	0.194		0.191		0.192		0.193	
	Static Energy	3.898		3.907		3.946		3.922	
	Energy Dissipation	0.719		0.707		0.695		0.717	
Sensor 8 *	Umin	1.692	2.530	1.752	2.503	1.642	2.331	1.609	2.569
	Umax	6.188	6.230	5.945	6.152	6.085	6.209	6.131	6.230
	Compliance	0.871	1.147	0.810	1.057	0.834	1.094	0.846	1.103
	Compliance_Cycle	0.990		0.917		0.947		0.958	
	Static Energy	12.234		11.333		12.008		12.310	
	Energy Dissipation	2.913		2.592		2.604		2.928	
Sensor 9 *	Umin	1.852	2.862	1.983	3.184	1.581	2.696	1.556	3.041
	Umax	5.913	6.137	5.828	5.984	5.954	6.161	5.864	6.161
	Compliance	0.772	1.181	0.725	0.905	0.751	1.217	0.769	1.081
	Compliance_Cycle	0.934		0.805		0.929		0.899	
	Static Energy	11.050		10.393		11.819		11.728	
	Energy Dissipation	2.174		2.333		1.636		2.494	
Sensor 10	Umin	1.361	1.952	1.425	1.932	1.366	1.827	1.339	1.999
	Umax	7.720	7.616	7.710	7.672	7.714	7.714	7.690	7.690
	Compliance	1.153	1.265	1.152	1.229	1.150	1.232	1.151	1.266
	Compliance_Cycle	1.206		1.189		1.190		1.206	
	Static Energy	18.639		17.079		17.208		17.091	
	Energy Dissipation	4.860		4.722		4.696		4.875	

Config 1 Series 1 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.62	0.62	0.70	0.70	0.61	0.61	0.69
	Fmax	14.89	14.89	18.59	18.59	13.29	13.29	13.18	13.18
Sensor 1	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 2	Umin	-0.002	0.229	0.206	0.351	0.324	0.311	0.299	0.342
	Umax	3.269	3.303	3.767	3.770	2.813	2.828	2.795	2.833
	Compliance	0.221	0.223	0.203	0.220	0.214	0.209	0.203	0.209
	Compliance_Cycle	0.222		0.211		0.211		0.206	
	Static Energy	23.587		33.728		17.923		17.698	
	Energy Dissipation	4.884		7.658		3.541		3.404	
Sensor 3	Umin	-0.009	-0.417	-0.461	-0.371	-0.467	-0.501	-0.503	-0.408
	Umax	4.622	4.724	4.493	5.132	3.275	3.517	3.329	3.642
	Compliance	0.305	0.372	0.303	0.353	0.343	0.331	0.318	0.338
	Compliance_Cycle	0.335		0.326		0.337		0.328	
	Static Energy	36.691		50.033		25.464		25.893	
	Energy Dissipation	2.594		11.296		6.138		6.118	
Sensor 4	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 5	Umin	-0.001	0.597	0.570	0.846	0.844	0.842	0.840	0.880
	Umax	3.511	3.536	4.444	4.445	3.341	3.378	3.343	3.366
	Compliance	0.239	0.212	0.210	0.217	0.209	0.208	0.198	0.205
	Compliance_Cycle	0.225		0.213		0.208		0.201	
	Static Energy	25.243		39.767		21.408		21.027	
	Energy Dissipation	8.530		10.337		3.790		3.601	
Sensor 6	Umin	-0.013	0.626	0.581	-0.078	-0.083	0.140	0.150	0.189
	Umax	4.453	4.453	4.477	4.478	3.073	3.118	3.416	3.534
	Compliance	0.312	0.271	0.235	0.274	0.286	0.243	0.259	0.276
	Compliance_Cycle	0.290		0.253		0.263		0.267	
	Static Energy	31.869		40.755		20.284		22.077	
	Energy Dissipation	7.846		-4.010		5.759		5.181	
Sensor 7	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 8	Umin	0.000	0.562	0.539	0.771	0.766	0.766	0.763	0.798
	Umax	3.536	3.545	4.461	4.462	3.341	3.353	3.321	3.333
	Compliance	0.241	0.215	0.214	0.221	0.213	0.212	0.203	0.209
	Compliance_Cycle	0.227		0.218		0.212		0.206	
	Static Energy	25.299		39.919		21.250		20.821	
	Energy Dissipation	7.640		9.386		3.631		3.426	
Sensor 9	Umin	-0.008	0.717	0.671	0.671	0.737	0.741	0.734	0.802
	Umax	4.765	4.814	5.254	5.279	4.278	4.357	4.271	4.341
	Compliance	0.340	0.297	0.306	0.347	0.305	0.298	0.282	0.294
	Compliance_Cycle	0.317		0.325		0.302		0.288	
	Static Energy	34.412		47.228		27.613		27.118	
	Energy Dissipation	11.735		0.276		6.703		6.447	
Sensor 10	Umin	0.000	0.466	0.467	0.641	0.635	0.647	0.648	0.677
	Umax	2.880	2.899	3.701	3.704	2.753	2.762	2.724	2.724
	Compliance	0.199	0.177	0.176	0.183	0.174	0.174	0.163	0.171
	Compliance_Cycle	0.187		0.180		0.174		0.167	
	Static Energy	20.689		33.137		17.504		17.017	
	Energy Dissipation	7.286		8.141		3.575		3.098	

Config 1 **Series 1** **Table B**	**Loading / Unloading**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
	Fmin	0.69	0.53	0.53	0.57	0.57	0.69	0.69	0.57
	Fmax	13.11	13.11	11.05	11.05	12.68	12.68	13.25	13.25
Sensor 1	**Umin**								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 2	**Umin**	0.322	0.277	0.275	0.308	0.278	0.329	0.286	0.300
	Umax	2.789	2.793	2.345	2.580	2.609	2.610	2.758	2.792
	Compliance	0.201	0.211	0.208	0.198	0.196	0.208	0.203	0.207
	Compliance_Cycle	0.206		0.202		0.202		0.205	
	Static Energy	17.562		13.520		15.650		17.703	
	Energy Dissipation	3.507		3.270		2.950		3.339	
Sensor 3	**Umin**	-0.494	-0.531	-0.531	-0.460	-0.521	-0.449	-0.518	-0.481
	Umax	3.347	3.470	2.667	3.117	2.822	3.030	3.181	3.498
	Compliance	0.316	0.340	0.338	0.299	0.295	0.324	0.323	0.327
	Compliance_Cycle	0.328		0.318		0.309		0.325	
	Static Energy	25.156		19.116		21.295		25.465	
	Energy Dissipation	6.834		6.443		4.972		6.074	
Sensor 4	**Umin**								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 5	**Umin**	0.869	0.852	0.849	0.865	0.850	0.904	0.873	0.881
	Umax	3.373	3.384	2.897	3.180	3.241	3.248	3.380	3.389
	Compliance	0.199	0.208	0.198	0.199	0.197	0.207	0.198	0.206
	Compliance_Cycle	0.203		0.199		0.202		0.202	
	Static Energy	21.278		16.665		19.476		21.489	
	Energy Dissipation	3.544		3.020		3.196		3.394	
Sensor 6	**Umin**	0.156	0.151	0.142	0.216	0.191	0.362	0.366	0.345
	Umax	3.518	3.589	2.900	3.387	3.273	3.297	3.706	3.824
	Compliance	0.265	0.279	0.266	0.269	0.258	0.262	0.264	0.283
	Compliance_Cycle	0.272		0.268		0.260		0.273	
	Static Energy	22.567		17.749		19.770		24.247	
	Energy Dissipation	5.625		5.269		4.210		5.071	
Sensor 7	**Umin**								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 8	**Umin**	0.788	0.770	0.766	0.781	0.768	0.817	0.789	0.796
	Umax	3.341	3.341	2.859	3.142	3.224	3.225	3.352	3.356
	Compliance	0.203	0.211	0.201	0.203	0.201	0.211	0.202	0.210
	Compliance_Cycle	0.207		0.202		0.206		0.206	
	Static Energy	21.008		16.465		19.338		21.280	
	Energy Dissipation	3.339		2.975		3.091		3.366	
Sensor 9	**Umin**	0.771	0.752	0.735	0.764	0.735	0.818	0.758	0.782
	Umax	4.357	4.366	3.684	4.070	4.118	4.155	4.281	4.347
	Compliance	0.285	0.300	0.286	0.286	0.281	0.300	0.283	0.296
	Compliance_Cycle	0.293		0.286		0.290		0.289	
	Static Energy	27.453		21.329		24.915		27.563	
	Energy Dissipation	6.491		5.730		5.934		6.419	
Sensor 10	**Umin**	0.669	0.653	0.654	0.667	0.655	0.699	0.674	0.679
	Umax	2.720	2.720	2.381	2.585	2.628	2.632	2.738	2.743
	Compliance	0.163	0.173	0.162	0.166	0.162	0.173	0.163	0.171
	Compliance_Cycle	0.168		0.164		0.168		0.167	
	Static Energy	17.103		13.547		15.782		17.393	
	Energy Dissipation	3.097		2.670		2.836		3.047	

Config 1 Series 2 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.53	0.53	0.45	0.45	0.38	0.38	0.60
	Fmax	12.55	12.55	12.67	12.67	13.37	13.37	14.67	14.67
Sensor 1	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 2	Umin	-0.005	-0.704	-0.728	-0.712	-0.716	-0.715	-0.722	-0.646
	Umax	1.799	1.861	1.865	1.895	1.918	1.922	2.255	2.260
	Compliance	0.136	0.227	0.211	0.222	0.205	0.230	0.208	0.229
	Compliance_Cycle	0.170		0.216		0.216		0.218	
	Static Energy	15.420		16.023		17.131		20.974	
	Energy Dissipation	-0.947		3.656		3.917		4.689	
Sensor 3 *	Umin	-0.170	-0.786	-0.955	-0.923	-0.971	-0.956	-0.956	-0.981
	Umax	0.837	1.075	0.996	1.107	0.857	0.902	1.584	1.725
	Compliance	0.053	0.174	0.148	0.185	0.152	0.169	0.190	0.228
	Compliance_Cycle	0.081		0.164		0.160		0.207	
	Static Energy	11.185		12.592		12.158		19.034	
	Energy Dissipation	-4.978		3.410		4.176		5.699	
Sensor 4	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 5	Umin	-0.017	-0.017	-0.025	0.014	0.012	0.044	0.008	0.084
	Umax	2.360	2.431	2.394	2.420	2.496	2.503	2.790	2.792
	Compliance	0.185	0.212	0.199	0.207	0.193	0.214	0.195	0.215
	Compliance_Cycle	0.197		0.203		0.203		0.204	
	Static Energy	14.717		14.936		16.254		19.639	
	Energy Dissipation	3.542		3.660		3.708		4.637	
Sensor 6	Umin	-0.063	-0.166	-0.171	-0.107	-0.116	-0.097	-0.141	-0.021
	Umax	3.245	3.482	3.326	3.539	3.316	3.447	3.810	4.157
	Compliance	0.252	0.317	0.282	0.308	0.266	0.317	0.274	0.321
	Compliance_Cycle	0.281		0.295		0.289		0.295	
	Static Energy	21.929		22.662		23.135		30.236	
	Energy Dissipation	7.569		7.110		7.499		9.130	
Sensor 7	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 8	Umin	0.000	0.122	0.099	0.127	0.125	0.130	0.128	0.196
	Umax	2.581	2.632	2.634	2.645	2.738	2.738	3.042	3.042
	Compliance	0.203	0.217	0.207	0.212	0.203	0.219	0.203	0.219
	Compliance_Cycle	0.210		0.209		0.210		0.211	
	Static Energy	15.823		16.156		17.780		21.398	
	Energy Dissipation	3.379		3.077		3.349		4.167	
Sensor 9	Umin	-0.011	0.203	0.170	0.174	0.163	0.181	0.172	0.278
	Umax	3.615	3.819	3.759	3.832	3.864	3.883	4.277	4.288
	Compliance	0.286	0.313	0.294	0.309	0.287	0.321	0.288	0.317
	Compliance_Cycle	0.299		0.301		0.303		0.302	
	Static Energy	23.024		23.407		25.215		30.162	
	Energy Dissipation	7.245		5.356		6.315		7.485	
Sensor 10	Umin	0.003	0.129	0.118	0.117	0.118	0.129	0.129	0.149
	Umax	2.063	2.117	2.152	2.173	2.245	2.245	2.512	2.512
	Compliance	0.165	0.173	0.167	0.172	0.166	0.177	0.167	0.178
	Compliance_Cycle	0.169		0.169		0.171		0.172	
	Static Energy	12.725		13.273		14.578		17.670	
	Energy Dissipation	3.011		2.518		2.295		3.084	

Config 1 Series 2 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.60	0.58	0.58	0.66	0.66	0.64	0.64	0.56
	Fmax	13.16	13.16	12.75	12.75	12.74	12.74	12.70	12.70
Sensor 1	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 2	Umin	-0.716	-0.661	-0.734	-0.649	-0.712	-0.619	-0.700	-0.637
	Umax	1.899	1.905	1.887	1.926	1.895	1.896	1.846	1.846
	Compliance	0.202	0.225	0.208	0.222	0.208	0.222	0.204	0.222
	Compliance_Cycle	0.213		0.215		0.215		0.213	
	Static Energy	16.484		16.077		15.775		15.451	
	Energy Dissipation	3.827		3.524		3.750		3.556	
Sensor 3 *	Umin	-0.981	-0.980	-0.980	-0.974	-0.974	-0.929	-0.975	-0.963
	Umax	0.914	0.977	0.978	1.111	1.042	1.055	0.872	0.949
	Compliance	0.142	0.185	0.157	0.192	0.149	0.193	0.139	0.191
	Compliance_Cycle	0.161		0.173		0.169		0.161	
	Static Energy	12.309		12.637		12.274		11.674	
	Energy Dissipation	4.636		4.209		4.679		4.009	
Sensor 4	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 5	Umin	0.015	0.077	-0.001	0.092	0.029	0.114	0.039	0.093
	Umax	2.494	2.498	2.426	2.465	2.460	2.464	2.410	2.412
	Compliance	0.190	0.212	0.193	0.207	0.193	0.208	0.191	0.209
	Compliance_Cycle	0.200		0.200		0.200		0.199	
	Static Energy	15.709		14.903		14.904		14.637	
	Energy Dissipation	3.846		3.608		3.730		3.639	
Sensor 6	Umin	-0.138	-0.031	-0.194	-0.064	-0.128	0.031	-0.125	-0.019
	Umax	3.404	3.544	3.303	3.446	3.415	3.430	3.276	3.430
	Compliance	0.263	0.315	0.273	0.305	0.271	0.311	0.268	0.312
	Compliance_Cycle	0.287		0.288		0.290		0.288	
	Static Energy	23.157		22.002		21.519		21.576	
	Energy Dissipation	8.248		7.050		8.068		7.925	
Sensor 7	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 8	Umin	0.138	0.197	0.127	0.219	0.155	0.222	0.159	0.209
	Umax	2.719	2.720	2.662	2.704	2.675	2.675	2.647	2.647
	Compliance	0.198	0.216	0.201	0.213	0.202	0.213	0.200	0.213
	Compliance_Cycle	0.207		0.207		0.207		0.206	
	Static Energy	17.105		16.344		16.180		16.063	
	Energy Dissipation	3.360		3.173		3.174		3.137	
Sensor 9	Umin	0.184	0.269	0.161	0.288	0.181	0.293	0.195	0.274
	Umax	3.811	3.867	3.819	3.882	3.807	3.804	3.717	3.745
	Compliance	0.280	0.315	0.287	0.309	0.287	0.309	0.282	0.308
	Compliance_Cycle	0.296		0.298		0.298		0.294	
	Static Energy	24.318		23.464		23.027		22.727	
	Energy Dissipation	6.555		5.611		6.022		6.002	
Sensor 10	Umin	0.128	0.190	0.123	0.182	0.144	0.181	0.147	0.184
	Umax	2.225	2.226	2.207	2.230	2.175	2.175	2.161	2.161
	Compliance	0.161	0.174	0.166	0.173	0.163	0.172	0.161	0.172
	Compliance_Cycle	0.167		0.170		0.167		0.166	
	Static Energy	13.998		13.479		13.155		13.114	
	Energy Dissipation	2.525		2.216		2.294		2.325	

Config 1 Series 3 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.69	0.69	0.53	0.53	0.64	0.64	0.61
	Fmax	14.25	14.25	13.78	13.78	13.16	13.16	12.39	12.39
Sensor 1	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 2	Umin	0.000	0.104	0.044	0.079	0.038	0.086	0.051	0.078
	Umax	2.849	2.863	2.693	2.813	2.620	2.621	2.467	2.476
	Compliance	0.208	0.220	0.200	0.214	0.203	0.216	0.200	0.216
	Compliance_Cycle	0.214		0.207		0.209		0.207	
	Static Energy	19.406		18.641		16.413		14.581	
	Energy Dissipation	4.275		4.147		3.497		3.266	
Sensor 3	Umin	0.001	-0.033	-0.112	-0.061	-0.143	-0.067	-0.140	-0.084
	Umax	4.373	4.674	3.999	4.617	4.046	4.257	3.846	3.968
	Compliance	0.331	0.377	0.321	0.366	0.334	0.368	0.323	0.371
	Compliance_Cycle	0.353		0.342		0.350		0.345	
	Static Energy	31.900		31.340		27.552		24.189	
	Energy Dissipation	8.140		8.671		7.049		6.946	
Sensor 4	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 5	Umin	-0.058	0.132	0.058	0.109	0.063	0.103	0.064	0.110
	Umax	2.763	2.784	2.631	2.762	2.561	2.577	2.405	2.410
	Compliance	0.206	0.211	0.190	0.207	0.194	0.209	0.193	0.207
	Compliance_Cycle	0.208		0.198		0.201		0.200	
	Static Energy	19.263		18.303		16.138		14.192	
	Energy Dissipation	5.333		4.253		3.468		3.236	
Sensor 6	Umin	-0.069	0.195	0.047	0.167	0.048	0.114	0.047	0.140
	Umax	3.776	4.259	3.448	4.031	3.529	3.793	3.313	3.472
	Compliance	0.289	0.309	0.251	0.301	0.271	0.308	0.268	0.302
	Compliance_Cycle	0.299		0.274		0.288		0.284	
	Static Energy	29.333		26.712		23.753		20.446	
	Energy Dissipation	10.550		8.530		6.545		6.461	
Sensor 7	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 8	Umin	-0.007	0.169	0.106	0.150	0.114	0.155	0.120	0.091
	Umax	2.948	2.948	2.825	2.837	2.702	2.702	2.480	2.482
	Compliance	0.213	0.215	0.201	0.210	0.202	0.211	0.193	0.210
	Compliance_Cycle	0.214		0.206		0.206		0.201	
	Static Energy	20.026		18.800		16.921		14.616	
	Energy Dissipation	4.346		3.801		3.171		2.722	
Sensor 9	Umin	-0.025	0.197	0.106	0.176	0.111	0.174	0.119	0.095
	Umax	3.994	4.128	3.925	4.018	3.773	3.791	3.508	3.513
	Compliance	0.302	0.307	0.285	0.301	0.287	0.305	0.275	0.303
	Compliance_Cycle	0.305		0.293		0.296		0.289	
	Static Energy	28.145		26.626		23.740		20.688	
	Energy Dissipation	7.987		7.088		5.739		5.229	
Sensor 10	Umin	-0.005	0.124	0.077	0.127	0.094	0.118	0.093	0.120
	Umax	2.454	2.458	2.270	2.297	2.182	2.182	2.032	2.047
	Compliance	0.170	0.174	0.161	0.169	0.163	0.171	0.160	0.170
	Compliance_Cycle	0.172		0.165		0.167		0.165	
	Static Energy	16.692		15.222		13.664		12.055	
	Energy Dissipation	3.919		3.122		2.340		2.338	

Config 1 Series 3 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.61	0.63	0.63	0.53	0.53	0.66		
	Fmax	14.11	14.11	13.52	13.52	13.67	13.67		
Sensor 1	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 2	Umin	0.022	0.098	0.026	0.077	0.036	0.118		
	Umax	2.792	2.816	2.717	2.717	2.719	2.720		
	Compliance	0.203	0.223	0.204	0.222	0.202	0.214		
	Compliance_Cycle	0.212		0.213		0.208			
	Static Energy	18.984		17.653		17.692			
	Energy Dissipation	4.060		3.544		3.662			
Sensor 3	Umin	-0.186	-0.059	-0.194	-0.094	-0.176	-0.061		
	Umax	4.283	4.450	4.223	4.269	4.194	4.414		
	Compliance	0.333	0.384	0.339	0.382	0.332	0.369		
	Compliance_Cycle	0.357		0.360		0.349			
	Static Energy	31.253		28.999		29.856			
	Energy Dissipation	8.478		6.845		7.248			
Sensor 4	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 5	Umin	0.047	0.133	0.070	0.100	0.078	0.156		
	Umax	2.687	2.714	2.627	2.627	2.661	2.668		
	Compliance	0.195	0.212	0.195	0.214	0.196	0.207		
	Compliance_Cycle	0.203		0.204		0.201			
	Static Energy	18.296		17.068		17.354			
	Energy Dissipation	4.075		3.578		3.717			
Sensor 6	Umin	0.017	0.147	0.072	0.081	0.059	0.169		
	Umax	3.447	3.801	3.571	3.764	3.635	3.922		
	Compliance	0.268	0.309	0.272	0.314	0.275	0.303		
	Compliance_Cycle	0.287		0.291		0.289			
	Static Energy	25.624		24.455		25.510			
	Energy Dissipation	7.332		6.460		6.631			
Sensor 7	Umin								
	Umax								
	Compliance								
	Compliance_Cycle								
	Static Energy								
	Energy Dissipation								
Sensor 8	Umin	0.032	0.114	0.045	0.090	0.055	0.135		
	Umax	2.838	2.856	2.713	2.713	2.757	2.757		
	Compliance	0.202	0.216	0.202	0.216	0.202	0.210		
	Compliance_Cycle	0.209		0.209		0.206			
	Static Energy	19.254		17.627		17.932			
	Energy Dissipation	3.686		3.356		3.483			
Sensor 9	Umin	0.013	0.127	0.016	0.086	0.028	0.153		
	Umax	3.942	3.992	3.769	3.808	3.851	3.864		
	Compliance	0.287	0.311	0.287	0.313	0.287	0.300		
	Compliance_Cycle	0.299		0.299		0.294			
	Static Energy	26.912		24.741		25.133			
	Energy Dissipation	6.146		6.000		6.251			
Sensor 10	Umin	0.077	0.139	0.079	0.128	0.096	0.143		
	Umax	2.319	2.329	2.243	2.243	2.269	2.269		
	Compliance	0.162	0.175	0.164	0.174	0.164	0.170		
	Compliance_Cycle	0.168		0.169		0.167			
	Static Energy	15.701		14.573		14.758			
	Energy Dissipation	3.234		2.544		2.662			

Config 2 Series 1 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.49	0.49	0.47	0.47	0.62	0.62	0.65
	Fmax	13.57	13.57	12.86	12.86	12.92	12.92	13.71	13.71
Sensor 1	Umin	-0.002	0.019	0.016	0.019	0.016	0.022	0.015	0.022
	Umax	0.372	0.372	0.331	0.331	0.346	0.346	0.368	0.368
	Compliance	0.028	0.031	0.026	0.028	0.027	0.030	0.027	0.029
	Compliance_Cycle	0.029		0.027		0.028		0.028	
	Static Energy	2.444		2.052		2.130		2.400	
	Energy Dissipation	0.368		0.437		0.403		0.408	
Sensor 2	Umin	-0.002	0.209	0.204	0.213	0.175	0.229	0.197	0.230
	Umax	2.659	2.662	2.520	2.520	2.515	2.513	2.646	2.646
	Compliance	0.195	0.211	0.191	0.203	0.189	0.208	0.185	0.205
	Compliance_Cycle	0.203		0.196		0.198		0.194	
	Static Energy	17.422		15.616		15.472		17.274	
	Energy Dissipation	3.964		2.973		3.150		3.519	
Sensor 3	Umin	0.001	0.445	0.414	0.492	0.289	0.431	0.420	0.402
	Umax	4.308	4.390	4.047	4.107	4.045	4.054	4.184	4.251
	Compliance	0.325	0.361	0.318	0.336	0.308	0.354	0.295	0.347
	Compliance_Cycle	0.342		0.326		0.329		0.319	
	Static Energy	28.714		25.450		24.940		27.753	
	Energy Dissipation	8.036		5.541		6.543		7.257	
Sensor 4	Umin	0.000	0.035	0.034	0.033	0.032	0.040	0.030	0.043
	Umax	0.657	0.657	0.615	0.615	0.618	0.613	0.659	0.657
	Compliance	0.047	0.052	0.046	0.050	0.046	0.051	0.045	0.050
	Compliance_Cycle	0.049		0.048		0.048		0.047	
	Static Energy	4.298		3.808		3.801		4.300	
	Energy Dissipation	1.138		0.990		0.978		1.109	
Sensor 5	Umin	-0.001	0.156	0.134	0.147	0.122	0.184	0.130	0.178
	Umax	2.430	2.448	2.310	2.311	2.301	2.301	2.427	2.428
	Compliance	0.176	0.197	0.177	0.191	0.176	0.195	0.175	0.193
	Compliance_Cycle	0.186		0.184		0.185		0.184	
	Static Energy	16.018		14.321		14.156		15.851	
	Energy Dissipation	4.188		3.214		3.025		3.335	
Sensor 6	Umin	-0.016	0.243	0.151	0.220	0.120	0.262	0.130	0.265
	Umax	3.218	3.579	3.123	3.387	3.080	3.285	3.141	3.489
	Compliance	0.234	0.284	0.241	0.273	0.238	0.278	0.237	0.277
	Compliance_Cycle	0.257		0.256		0.256		0.256	
	Static Energy	23.514		20.989		20.209		22.778	
	Energy Dissipation	8.926		6.535		5.891		6.302	
Sensor 7	Umin	0.000	0.043	0.041	0.042	0.040	0.048	0.040	0.049
	Umax	0.476	0.476	0.456	0.456	0.460	0.459	0.488	0.488
	Compliance	0.034	0.037	0.034	0.035	0.034	0.036	0.033	0.036
	Compliance_Cycle	0.035		0.034		0.035		0.034	
	Static Energy	3.111		2.828		2.828		3.185	
	Energy Dissipation	0.758		0.474		0.482		0.563	
Sensor 8	Umin	-0.001	0.168	0.166	0.165	0.162	0.203	0.164	0.205
	Umax	2.653	2.654	2.506	2.506	2.528	2.514	2.675	2.672
	Compliance	0.191	0.204	0.188	0.200	0.188	0.203	0.186	0.201
	Compliance_Cycle	0.197		0.194		0.196		0.193	
	Static Energy	17.363		15.529		15.552		17.464	
	Energy Dissipation	3.534		2.806		2.772		3.053	
Sensor 9	Umin	-0.007	0.231	0.223	0.222	0.218	0.284	0.217	0.285
	Umax	3.583	3.632	3.377	3.406	3.402	3.402	3.581	3.596
	Compliance	0.257	0.281	0.254	0.274	0.255	0.279	0.251	0.276
	Compliance_Cycle	0.268		0.263		0.267		0.263	
	Static Energy	23.805		21.106		20.929		23.476	
	Energy Dissipation	6.079		4.836		4.719		5.203	
Sensor 10	Umin	0.003	0.147	0.144	0.144	0.141	0.171	0.143	0.170
	Umax	2.156	2.159	2.053	2.053	2.063	2.063	2.179	2.179
	Compliance	0.156	0.165	0.154	0.161	0.153	0.164	0.152	0.163
	Compliance_Cycle	0.160		0.158		0.158		0.157	
	Static Energy	14.121		12.722		12.692		14.226	
	Energy Dissipation	2.760		1.694		1.814		2.045	

Config 2 Series 1 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.56	0.70	0.70	0.68	0.68	0.67	0.67	0.56
	Fmax	12.80	12.80	12.97	12.97	12.63	12.63	12.90	12.90
Sensor 1	Umin	0.010	0.026	0.010	0.025	0.015	0.021	0.012	0.018
	Umax	0.327	0.328	0.330	0.330	0.321	0.321	0.328	0.328
	Compliance	0.026	0.029	0.025	0.028	0.025	0.029	0.026	0.027
	Compliance_Cycle	0.027		0.027		0.027		0.027	
	Static Energy	1.984		2.029		1.921		2.024	
	Energy Dissipation	0.491		0.516		0.495		0.502	
Sensor 2	Umin	0.076	0.200	0.073	0.193	0.087	0.194	0.103	0.170
	Umax	2.649	2.651	2.675	2.677	2.612	2.613	2.672	2.674
	Compliance	0.207	0.222	0.204	0.218	0.205	0.220	0.206	0.216
	Compliance_Cycle	0.214		0.211		0.212		0.211	
	Static Energy	16.043		16.447		15.632		16.494	
	Energy Dissipation	3.031		3.031		2.961		3.103	
Sensor 3	Umin	0.153	0.388	0.111	0.346	0.132	0.411	0.166	0.313
	Umax	4.632	4.702	4.651	4.778	4.560	4.682	4.766	4.771
	Compliance	0.366	0.391	0.355	0.392	0.362	0.392	0.364	0.385
	Compliance_Cycle	0.378		0.373		0.377		0.374	
	Static Energy	28.455		29.354		28.010		29.428	
	Energy Dissipation	5.324		5.372		5.151		5.424	
Sensor 4	Umin	0.016	0.052	0.016	0.051	0.028	0.047	0.025	0.044
	Umax	0.577	0.577	0.586	0.587	0.568	0.568	0.584	0.575
	Compliance	0.044	0.047	0.043	0.045	0.043	0.046	0.044	0.045
	Compliance_Cycle	0.045		0.044		0.044		0.045	
	Static Energy	3.493		3.603		3.400		3.602	
	Energy Dissipation	0.810		0.812		0.758		0.789	
Sensor 5	Umin	0.075	0.193	0.074	0.192	0.105	0.194	0.119	0.178
	Umax	2.470	2.472	2.457	2.462	2.426	2.427	2.538	2.528
	Compliance	0.190	0.206	0.187	0.201	0.187	0.203	0.192	0.201
	Compliance_Cycle	0.198		0.194		0.195		0.196	
	Static Energy	14.960		15.126		14.520		15.655	
	Energy Dissipation	3.093		2.953		2.865		3.255	
Sensor 6	Umin	0.074	0.265	0.093	0.245	0.119	0.288	0.160	0.205
	Umax	3.447	3.496	3.197	3.748	3.297	3.443	3.775	3.794
	Compliance	0.266	0.303	0.254	0.294	0.257	0.296	0.277	0.300
	Compliance_Cycle	0.284		0.272		0.275		0.288	
	Static Energy	21.157		23.026		20.598		23.402	
	Energy Dissipation	6.401		5.721		5.416		7.471	
Sensor 7	Umin	0.017	0.037	0.016	0.037	0.022	0.036	0.024	0.035
	Umax	0.450	0.451	0.457	0.457	0.444	0.444	0.456	0.452
	Compliance	0.034	0.037	0.034	0.036	0.034	0.036	0.034	0.036
	Compliance_Cycle	0.036		0.035		0.035		0.035	
	Static Energy	2.726		2.806		2.656		2.811	
	Energy Dissipation	0.529		0.529		0.511		0.529	
Sensor 8	Umin	0.097	0.201	0.095	0.208	0.115	0.190	0.122	0.186
	Umax	2.643	2.644	2.679	2.681	2.618	2.619	2.683	2.655
	Compliance	0.204	0.218	0.203	0.213	0.202	0.216	0.205	0.212
	Compliance_Cycle	0.211		0.208		0.209		0.209	
	Static Energy	16.001		16.471		15.668		16.549	
	Energy Dissipation	2.768		2.771		2.577		2.829	
Sensor 9	Umin	0.114	0.312	0.132	0.309	0.174	0.256	0.190	0.262
	Umax	3.632	3.669	3.663	3.699	3.619	3.625	3.777	3.757
	Compliance	0.283	0.306	0.282	0.298	0.282	0.304	0.286	0.301
	Compliance_Cycle	0.294		0.290		0.292		0.293	
	Static Energy	22.204		22.725		21.687		23.297	
	Energy Dissipation	5.129		5.217		4.678		5.569	
Sensor 10	Umin	0.084	0.171	0.121	0.165	0.127	0.130	0.101	0.114
	Umax	2.138	2.139	2.169	2.174	2.134	2.135	2.174	2.174
	Compliance	0.164	0.176	0.163	0.172	0.161	0.176	0.164	0.173
	Compliance_Cycle	0.170		0.167		0.169		0.168	
	Static Energy	12.945		13.356		12.773		13.410	
	Energy Dissipation	2.148		2.074		2.221		2.297	

Config 2 Series 2 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.45	0.45	0.49	0.49	0.42	0.42	0.44
	Fmax	12.45	12.45	13.39	13.39	13.08	13.08	12.87	12.87
Sensor 1	Umin	0.000	0.025	0.022	0.030	0.025	0.025	0.025	0.030
	Umax	0.338	0.338	0.364	0.364	0.356	0.356	0.350	0.351
	Compliance	0.027	0.029	0.027	0.029	0.027	0.029	0.027	0.028
	Compliance_Cycle	0.028		0.028		0.028		0.028	
	Static Energy	2.030		2.349		2.256		2.179	
	Energy Dissipation	0.362		0.413		0.397		0.382	
Sensor 2	Umin	0.000	0.170	0.150	0.188	0.183	0.178	0.169	0.186
	Umax	2.419	2.420	2.588	2.588	2.517	2.529	2.478	2.479
	Compliance	0.192	0.210	0.189	0.206	0.186	0.208	0.189	0.201
	Compliance_Cycle	0.200		0.197		0.197		0.195	
	Static Energy	14.519		16.689		16.006		15.406	
	Energy Dissipation	3.214		3.437		3.228		3.121	
Sensor 3	Umin	0.000	0.385	0.254	0.416	0.415	0.421	0.378	0.427
	Umax	3.989	4.026	4.213	4.232	4.042	4.186	3.969	4.054
	Compliance	0.321	0.359	0.313	0.350	0.302	0.357	0.311	0.335
	Compliance_Cycle	0.339		0.330		0.327		0.322	
	Static Energy	24.157		27.290		26.494		25.194	
	Energy Dissipation	6.493		7.156		6.776		6.357	
Sensor 4	Umin	0.000	0.031	0.031	0.034	0.032	0.030	0.029	0.030
	Umax	0.586	0.586	0.634	0.634	0.618	0.620	0.605	0.605
	Compliance	0.045	0.050	0.045	0.050	0.045	0.050	0.045	0.049
	Compliance_Cycle	0.047		0.047		0.047		0.047	
	Static Energy	3.515		4.089		3.923		3.762	
	Energy Dissipation	0.961		1.039		0.990		0.960	
Sensor 5	Umin	-0.003	0.138	0.128	0.173	0.154	0.139	0.119	0.130
	Umax	2.250	2.250	2.400	2.402	2.360	2.377	2.304	2.304
	Compliance	0.179	0.196	0.176	0.193	0.175	0.195	0.179	0.190
	Compliance_Cycle	0.187		0.184		0.185		0.184	
	Static Energy	13.516		15.489		15.044		14.319	
	Energy Dissipation	3.055		3.175		3.059		2.873	
Sensor 6	Umin	-0.015	0.223	0.174	0.289	0.209	0.251	0.161	0.192
	Umax	3.081	3.234	3.229	3.476	3.176	3.390	3.063	3.261
	Compliance	0.245	0.282	0.239	0.275	0.236	0.280	0.246	0.268
	Compliance_Cycle	0.262		0.255		0.256		0.256	
	Static Energy	19.491		22.415		21.456		20.266	
	Energy Dissipation	5.876		5.907		5.884		5.186	
Sensor 7	Umin	0.000	0.021	0.021	0.025	0.023	0.021	0.020	0.023
	Umax	0.417	0.417	0.454	0.454	0.443	0.444	0.435	0.435
	Compliance	0.033	0.036	0.033	0.036	0.033	0.036	0.033	0.035
	Compliance_Cycle	0.034		0.034		0.034		0.034	
	Static Energy	2.506		2.925		2.809		2.705	
	Energy Dissipation	0.489		0.534		0.509		0.494	
Sensor 8	Umin	-0.004	0.116	0.116	0.137	0.128	0.121	0.114	0.126
	Umax	2.378	2.378	2.558	2.558	2.503	2.516	2.453	2.454
	Compliance	0.186	0.202	0.186	0.201	0.185	0.201	0.187	0.198
	Compliance_Cycle	0.194		0.193		0.193		0.192	
	Static Energy	14.293		16.495		15.924		15.251	
	Energy Dissipation	2.690		2.869		2.723		2.646	
Sensor 9	Umin	-0.017	0.163	0.160	0.203	0.181	0.185	0.161	0.194
	Umax	3.231	3.248	3.446	3.446	3.373	3.434	3.302	3.379
	Compliance	0.252	0.277	0.251	0.275	0.250	0.277	0.252	0.271
	Compliance_Cycle	0.264		0.262		0.263		0.261	
	Static Energy	19.588		22.222		21.734		20.999	
	Energy Dissipation	4.621		4.981		4.733		4.591	
Sensor 10	Umin	0.000	0.102	0.079	0.105	0.103	0.075	0.073	0.079
	Umax	1.918	1.920	2.088	2.088	2.032	2.034	1.985	1.985
	Compliance	0.152	0.163	0.152	0.163	0.151	0.163	0.153	0.161
	Compliance_Cycle	0.157		0.157		0.157		0.157	
	Static Energy	11.522		13.465		12.873		12.336	
	Energy Dissipation	1.970		2.002		1.857		1.751	

Config 2 Series 2 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.44	0.49	0.49	0.48	0.48	0.50	0.50	0.48
	Fmax	13.73	13.73	12.68	12.68	12.51	12.51	12.67	12.67
Sensor 1	Umin	0.029	0.035	0.030	0.035	0.031	0.037	0.033	0.036
	Umax	0.374	0.375	0.354	0.354	0.344	0.344	0.349	0.350
	Compliance	0.027	0.028	0.027	0.029	0.027	0.029	0.027	0.029
	Compliance_Cycle	0.028		0.028		0.028		0.028	
	Static Energy	2.479		2.159		2.068		2.133	
	Energy Dissipation	0.437		0.367		0.367		0.382	
Sensor 2	Umin	0.186	0.213	0.206	0.200	0.195	0.209	0.201	0.196
	Umax	2.645	2.645	2.454	2.487	2.433	2.433	2.471	2.471
	Compliance	0.189	0.202	0.187	0.206	0.188	0.208	0.188	0.206
	Compliance_Cycle	0.195		0.196		0.197		0.197	
	Static Energy	17.512		15.166		14.615		15.061	
	Energy Dissipation	3.604		3.126		2.911		3.265	
Sensor 3	Umin	0.418	0.495	0.494	0.428	0.398	0.453	0.424	0.387
	Umax	4.196	4.326	3.961	4.179	3.948	3.961	3.993	4.006
	Compliance	0.307	0.336	0.302	0.354	0.309	0.352	0.308	0.354
	Compliance_Cycle	0.321		0.326		0.329		0.329	
	Static Energy	28.641		25.484		23.794		24.417	
	Energy Dissipation	7.647		6.632		5.900		6.997	
Sensor 4	Umin	0.030	0.036	0.033	0.035	0.033	0.035	0.034	0.033
	Umax	0.652	0.652	0.596	0.596	0.584	0.584	0.591	0.592
	Compliance	0.046	0.049	0.045	0.049	0.045	0.050	0.045	0.049
	Compliance_Cycle	0.048		0.047		0.047		0.047	
	Static Energy	4.319		3.637		3.509		3.608	
	Energy Dissipation	1.090		0.910		0.879		0.906	
Sensor 5	Umin	0.130	0.166	0.135	0.161	0.149	0.179	0.138	0.155
	Umax	2.426	2.427	2.281	2.292	2.246	2.247	2.273	2.292
	Compliance	0.177	0.190	0.177	0.192	0.176	0.193	0.176	0.192
	Compliance_Cycle	0.184		0.184		0.184		0.184	
	Static Energy	16.068		13.977		13.498		13.970	
	Energy Dissipation	3.295		2.846		2.723		2.867	
Sensor 6	Umin	0.169	0.253	0.176	0.264	0.179	0.321	0.193	0.261
	Umax	3.090	3.501	3.042	3.281	3.003	3.130	3.002	3.308
	Compliance	0.237	0.269	0.240	0.273	0.236	0.273	0.234	0.273
	Compliance_Cycle	0.252		0.256		0.253		0.252	
	Static Energy	23.179		20.008		18.802		20.162	
	Energy Dissipation	6.171		5.430		5.051		5.536	
Sensor 7	Umin	0.023	0.029	0.026	0.027	0.025	0.028	0.025	0.027
	Umax	0.468	0.468	0.432	0.433	0.424	0.424	0.428	0.428
	Compliance	0.033	0.035	0.033	0.035	0.033	0.035	0.033	0.035
	Compliance_Cycle	0.034		0.034		0.034		0.034	
	Static Energy	3.096		2.642		2.549		2.609	
	Energy Dissipation	0.578		0.463		0.438		0.484	
Sensor 8	Umin	0.127	0.145	0.133	0.140	0.135	0.146	0.139	0.140
	Umax	2.633	2.633	2.434	2.441	2.396	2.396	2.424	2.429
	Compliance	0.188	0.199	0.186	0.199	0.186	0.200	0.186	0.199
	Compliance_Cycle	0.193		0.193		0.193		0.192	
	Static Energy	17.432		14.885		14.393		14.805	
	Energy Dissipation	2.983		2.545		2.408		2.517	
Sensor 9	Umin	0.188	0.221	0.194	0.204	0.198	0.219	0.201	0.214
	Umax	3.554	3.586	3.327	3.368	3.283	3.292	3.307	3.341
	Compliance	0.254	0.273	0.252	0.276	0.251	0.277	0.253	0.275
	Compliance_Cycle	0.263		0.264		0.264		0.264	
	Static Energy	23.742		20.538		19.775		20.363	
	Energy Dissipation	5.285		4.533		4.217		4.482	
Sensor 10	Umin	0.073	0.092	0.084	0.096	0.091	0.101	0.092	0.072
	Umax	2.121	2.121	1.952	1.954	1.911	1.911	1.929	1.930
	Compliance	0.153	0.162	0.154	0.162	0.151	0.162	0.151	0.162
	Compliance_Cycle	0.157		0.158		0.156		0.156	
	Static Energy	14.042		11.916		11.479		11.763	
	Energy Dissipation	2.034		1.618		1.707		1.673	

Config 2 Series 3 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.46	0.46	0.45	0.45	0.47	0.47	0.40
	Fmax	13.12	13.12	12.91	12.91	12.99	12.99	13.09	13.09
Sensor 1	Umin	0.000	0.024	0.019	0.025	0.020	0.026	0.025	0.025
	Umax	0.350	0.351	0.343	0.343	0.347	0.347	0.351	0.351
	Compliance	0.027	0.029	0.027	0.028	0.027	0.027	0.027	0.029
	Compliance_Cycle	0.028		0.027		0.027		0.028	
	Static Energy	2.218		2.135		2.174		2.230	
	Energy Dissipation	0.419		0.370		0.403		0.400	
Sensor 2	Umin	0.001	0.136	0.120	0.130	0.128	0.140	0.135	0.128
	Umax	2.520	2.520	2.440	2.440	2.483	2.483	2.515	2.513
	Compliance	0.190	0.204	0.190	0.204	0.190	0.198	0.190	0.206
	Compliance_Cycle	0.197		0.197		0.194		0.198	
	Static Energy	15.950		15.196		15.540		15.962	
	Energy Dissipation	3.339		2.819		3.090		3.190	
Sensor 3	Umin	0.000	0.239	0.154	0.202	0.181	0.225	0.210	0.215
	Umax	4.035	4.098	3.854	3.982	3.973	4.034	4.050	4.084
	Compliance	0.316	0.346	0.318	0.346	0.315	0.332	0.315	0.351
	Compliance_Cycle	0.330		0.332		0.323		0.332	
	Static Energy	25.938		24.800		25.246		25.920	
	Energy Dissipation	6.482		5.225		6.282		6.531	
Sensor 4	Umin	0.000	0.032	0.031	0.032	0.031	0.032	0.032	0.028
	Umax	0.616	0.616	0.602	0.602	0.607	0.607	0.611	0.611
	Compliance	0.045	0.049	0.045	0.049	0.045	0.048	0.045	0.049
	Compliance_Cycle	0.047		0.047		0.046		0.047	
	Static Energy	3.899		3.751		3.801		3.879	
	Energy Dissipation	1.056		0.922		0.961		0.964	
Sensor 5	Umin	-0.003	0.157	0.123	0.156	0.122	0.151	0.143	0.129
	Umax	2.379	2.381	2.317	2.318	2.328	2.333	2.364	2.364
	Compliance	0.179	0.192	0.178	0.191	0.178	0.186	0.178	0.193
	Compliance_Cycle	0.185		0.184		0.182		0.185	
	Static Energy	15.092		14.437		14.601		15.004	
	Energy Dissipation	3.316		2.837		2.977		2.971	
Sensor 6	Umin	-0.046	0.249	0.157	0.284	0.163	0.222	0.185	0.204
	Umax	3.275	3.513	3.143	3.371	3.111	3.325	3.259	3.422
	Compliance	0.246	0.274	0.245	0.274	0.243	0.262	0.246	0.277
	Compliance_Cycle	0.259		0.259		0.252		0.261	
	Static Energy	22.529		20.995		20.809		21.719	
	Energy Dissipation	6.306		5.130		5.581		5.588	
Sensor 7	Umin	0.000	0.023	0.022	0.024	0.023	0.026	0.024	0.022
	Umax	0.443	0.443	0.436	0.436	0.440	0.440	0.442	0.442
	Compliance	0.033	0.035	0.033	0.035	0.033	0.035	0.033	0.036
	Compliance_Cycle	0.034		0.034		0.034		0.034	
	Static Energy	2.806		2.715		2.751		2.806	
	Energy Dissipation	0.562		0.478		0.504		0.510	
Sensor 8	Umin	0.000	0.117	0.111	0.120	0.115	0.125	0.122	0.111
	Umax	2.491	2.491	2.435	2.435	2.473	2.473	2.479	2.479
	Compliance	0.185	0.198	0.186	0.197	0.187	0.194	0.186	0.199
	Compliance_Cycle	0.192		0.191		0.190		0.192	
	Static Energy	15.766		15.165		15.477		15.734	
	Energy Dissipation	2.878		2.537		2.623		2.635	
Sensor 9	Umin	-0.004	0.186	0.162	0.190	0.174	0.191	0.184	0.163
	Umax	3.390	3.422	3.289	3.341	3.400	3.418	3.360	3.395
	Compliance	0.252	0.273	0.252	0.272	0.254	0.268	0.253	0.277
	Compliance_Cycle	0.262		0.261		0.261		0.264	
	Static Energy	21.682		20.808		21.391		21.547	
	Energy Dissipation	5.109		4.414		4.659		4.778	
Sensor 10	Umin	0.000	0.094	0.075	0.090	0.089	0.097	0.091	0.072
	Umax	2.027	2.028	1.983	1.983	1.993	1.993	2.022	2.022
	Compliance	0.152	0.162	0.152	0.162	0.153	0.159	0.153	0.162
	Compliance_Cycle	0.157		0.157		0.156		0.158	
	Static Energy	12.837		12.350		12.473		12.833	
	Energy Dissipation	2.058		1.776		1.755		1.723	

Config 2 Series 3 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.40	0.48	0.48	0.45	0.45	0.45		
	Fmax	13.08	13.08	13.30	13.30	12.94	12.94		
Sensor 1	Umin	0.023	0.025	0.023	0.026	0.023	0.026		
	Umax	0.349	0.349	0.354	0.354	0.351	0.351		
	Compliance	0.027	0.028	0.026	0.029	0.027	0.028		
	Compliance_Cycle	0.027		0.028		0.027			
	Static Energy	2.201		2.276		2.192			
	Energy Dissipation	0.381		0.400		0.395			
Sensor 2	Umin	0.128	0.148	0.139	0.143	0.137	0.153		
	Umax	2.486	2.486	2.489	2.489	2.490	2.490		
	Compliance	0.191	0.202	0.189	0.207	0.191	0.200		
	Compliance_Cycle	0.197		0.198		0.195			
	Static Energy	15.661		15.990		15.551			
	Energy Dissipation	3.278		3.207		3.225			
Sensor 3	Umin	0.209	0.215	0.210	0.190	0.187	0.279		
	Umax	3.928	4.092	3.792	3.994	4.009	4.136		
	Compliance	0.318	0.345	0.311	0.354	0.316	0.341		
	Compliance_Cycle	0.331		0.331		0.328			
	Static Energy	25.779		25.658		25.832			
	Energy Dissipation	6.802		6.601		6.972			
Sensor 4	Umin	0.028	0.033	0.030	0.032	0.031	0.031		
	Umax	0.610	0.610	0.621	0.621	0.604	0.603		
	Compliance	0.046	0.048	0.045	0.049	0.045	0.048		
	Compliance_Cycle	0.047		0.047		0.046			
	Static Energy	3.845		3.992		3.771			
	Energy Dissipation	0.967		0.991		0.939			
Sensor 5	Umin	0.127	0.163	0.120	0.144	0.125	0.154		
	Umax	2.350	2.366	2.342	2.343	2.313	2.337		
	Compliance	0.180	0.190	0.177	0.193	0.178	0.186		
	Compliance_Cycle	0.185		0.185		0.182			
	Static Energy	14.905		15.052		14.596			
	Energy Dissipation	2.991		3.015		3.005			
Sensor 6	Umin	0.162	0.265	0.151	0.230	0.157	0.263		
	Umax	3.169	3.488	3.014	3.396	3.059	3.376		
	Compliance	0.249	0.271	0.241	0.273	0.240	0.263		
	Compliance_Cycle	0.260		0.256		0.251			
	Static Energy	21.974		21.816		21.085			
	Energy Dissipation	5.508		5.426		5.826			
Sensor 7	Umin	0.022	0.026	0.023	0.027	0.025	0.026		
	Umax	0.445	0.445	0.449	0.449	0.441	0.441		
	Compliance	0.033	0.035	0.033	0.036	0.033	0.035		
	Compliance_Cycle	0.034		0.034		0.034			
	Static Energy	2.805		2.886		2.756			
	Energy Dissipation	0.495		0.541		0.494			
Sensor 8	Umin	0.113	0.132	0.120	0.125	0.120	0.120		
	Umax	2.475	2.475	2.516	2.516	2.464	2.464		
	Compliance	0.188	0.196	0.186	0.200	0.187	0.194		
	Compliance_Cycle	0.192		0.193		0.191			
	Static Energy	15.592		16.163		15.389			
	Energy Dissipation	2.651		2.719		2.631			
Sensor 9	Umin	0.173	0.211	0.181	0.193	0.182	0.193		
	Umax	3.361	3.391	3.401	3.434	3.401	3.401		
	Compliance	0.255	0.272	0.253	0.278	0.255	0.269		
	Compliance_Cycle	0.263		0.265		0.262			
	Static Energy	21.362		22.061		21.241			
	Energy Dissipation	4.826		4.907		4.915			
Sensor 10	Umin	0.071	0.091	0.083	0.074	0.072	0.078		
	Umax	2.014	2.014	2.048	2.048	1.982	1.983		
	Compliance	0.155	0.160	0.152	0.164	0.153	0.159		
	Compliance_Cycle	0.157		0.158		0.156			
	Static Energy	12.688		13.157		12.385			
	Energy Dissipation	1.720		1.835		1.797			

Config 3 Series 1 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.35	0.35	0.38	0.38	0.42	0.42	0.47
	Fmax	12.79	12.79	13.04	13.04	13.16	13.16	12.88	12.88
Sensor 1	Umin	0.000	-0.013	-0.014	-0.022	-0.023	-0.030	-0.032	-0.028
	Umax	0.316	0.317	0.313	0.313	0.305	0.305	0.296	0.297
	Compliance	0.024	0.029	0.027	0.030	0.027	0.029	0.028	0.029
	Compliance_Cycle	0.026		0.028		0.028		0.028	
	Static Energy	2.050		2.124		2.138		2.039	
	Energy Dissipation	0.328		0.359		0.368		0.378	
Sensor 2	Umin	0.000	-0.119	-0.123	-0.203	-0.204	-0.252	-0.257	-0.280
	Umax	2.203	2.213	2.146	2.158	2.084	2.084	2.051	2.053
	Compliance	0.171	0.202	0.181	0.207	0.184	0.204	0.187	0.204
	Compliance_Cycle	0.185		0.193		0.194		0.195	
	Static Energy	14.503		14.942		14.880		14.483	
	Energy Dissipation	1.429		2.026		2.508		2.636	
Sensor 3	Umin	-0.020	-0.558	-0.572	-0.784	-0.797	-0.911	-0.945	-0.999
	Umax	3.190	3.417	2.983	3.099	2.737	2.968	2.790	2.856
	Compliance	0.248	0.340	0.290	0.347	0.296	0.344	0.305	0.346
	Compliance_Cycle	0.287		0.316		0.318		0.324	
	Static Energy	24.721		24.577		24.712		23.928	
	Energy Dissipation	1.212		2.635		4.456		4.802	
Sensor 4	Umin	0.000	0.062	0.061	0.064	0.065	0.065	0.065	0.071
	Umax	0.633	0.634	0.647	0.648	0.655	0.655	0.643	0.643
	Compliance	0.048	0.048	0.046	0.050	0.046	0.049	0.047	0.049
	Compliance_Cycle	0.048		0.048		0.048		0.048	
	Static Energy	3.942		4.103		4.175		3.993	
	Energy Dissipation	1.211		1.022		1.029		0.969	
Sensor 5	Umin	0.000	0.207	0.208	0.219	0.221	0.233	0.222	0.282
	Umax	2.340	2.347	2.386	2.401	2.396	2.396	2.403	2.403
	Compliance	0.182	0.186	0.176	0.190	0.176	0.187	0.178	0.187
	Compliance_Cycle	0.184		0.183		0.181		0.182	
	Static Energy	14.597		15.198		15.264		14.915	
	Energy Dissipation	3.687		2.994		3.013		2.822	
Sensor 6	Umin	-0.007	0.290	0.288	0.298	0.288	0.320	0.306	0.421
	Umax	3.081	3.377	3.142	3.482	3.084	3.404	3.271	3.364
	Compliance	0.240	0.263	0.237	0.270	0.232	0.263	0.243	0.264
	Compliance_Cycle	0.251		0.253		0.247		0.253	
	Static Energy	21.045		22.040		21.685		20.880	
	Energy Dissipation	7.793		6.097		6.209		5.673	
Sensor 7	Umin	0.000	0.056	0.056	0.059	0.060	0.060	0.061	0.064
	Umax	0.393	0.393	0.410	0.410	0.415	0.415	0.409	0.409
	Compliance	0.030	0.029	0.028	0.030	0.028	0.030	0.028	0.029
	Compliance_Cycle	0.030		0.029		0.029		0.029	
	Static Energy	2.445		2.594		2.642		2.536	
	Energy Dissipation	0.755		0.449		0.436		0.399	
Sensor 8	Umin	-0.002	0.185	0.182	0.191	0.195	0.195	0.199	0.221
	Umax	2.466	2.468	2.513	2.521	2.543	2.543	2.508	2.508
	Compliance	0.192	0.192	0.185	0.198	0.186	0.195	0.187	0.194
	Compliance_Cycle	0.192		0.191		0.190		0.190	
	Static Energy	15.361		15.957		16.200		15.567	
	Energy Dissipation	3.064		2.590		2.643		2.478	
Sensor 9	Umin	-0.008	0.289	0.278	0.297	0.297	0.312	0.312	0.352
	Umax	3.356	3.399	3.397	3.444	3.455	3.477	3.454	3.472
	Compliance	0.264	0.264	0.251	0.272	0.251	0.268	0.254	0.268
	Compliance_Cycle	0.264		0.261		0.259		0.261	
	Static Energy	21.189		21.800		22.150		21.551	
	Energy Dissipation	5.439		4.523		4.774		4.345	
Sensor 10	Umin	0.000	0.198	0.201	0.199	0.200	0.222	0.222	0.230
	Umax	2.066	2.066	2.117	2.117	2.137	2.137	2.096	2.096
	Compliance	0.162	0.161	0.155	0.164	0.156	0.162	0.156	0.162
	Compliance_Cycle	0.162		0.159		0.159		0.159	
	Static Energy	12.849		13.400		13.614		13.010	
	Energy Dissipation	2.534		1.839		1.802		1.655	

Config 3 Series 1 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.47	0.46	0.46	0.46	0.46	0.40	0.40	0.46
	Fmax	13.22	13.22	12.84	12.84	13.29	13.29	12.71	12.71
Sensor 1	Umin	-0.031	-0.031	-0.036	-0.034	-0.039	-0.035	-0.040	-0.034
	Umax	0.301	0.301	0.290	0.290	0.298	0.298	0.281	0.281
	Compliance	0.027	0.030	0.027	0.029	0.027	0.027	0.027	0.028
	Compliance_Cycle	0.028		0.028		0.027		0.027	
	Static Energy	2.119		2.018		2.172		1.965	
	Energy Dissipation	0.394		0.396		0.420		0.394	
Sensor 2	Umin	-0.284	-0.292	-0.317	-0.305	-0.310	-0.315	-0.334	-0.297
	Umax	2.072	2.072	1.994	1.997	2.056	2.061	1.934	1.936
	Compliance	0.186	0.206	0.187	0.200	0.187	0.194	0.188	0.196
	Compliance_Cycle	0.196		0.193		0.191		0.192	
	Static Energy	15.077		14.326		15.312		13.904	
	Energy Dissipation	2.811		3.035		3.130		3.150	
Sensor 3	Umin	-0.999	-0.996	-0.997	-0.985	-1.000	-1.000	-1.000	-0.998
	Umax	2.728	2.802	2.617	2.689	2.675	2.813	2.436	2.652
	Compliance	0.302	0.346	0.302	0.333	0.296	0.318	0.297	0.327
	Compliance_Cycle	0.323		0.317		0.307		0.311	
	Static Energy	24.244		22.816		24.571		22.364	
	Energy Dissipation	5.324		6.133		6.284		6.447	
Sensor 4	Umin	0.069	0.072	0.069	0.072	0.069	0.071	0.067	0.074
	Umax	0.660	0.660	0.638	0.639	0.662	0.662	0.630	0.630
	Compliance	0.046	0.050	0.045	0.048	0.046	0.048	0.046	0.047
	Compliance_Cycle	0.048		0.047		0.047		0.046	
	Static Energy	4.206		3.953		4.267		3.861	
	Energy Dissipation	1.009		0.960		1.024		0.930	
Sensor 5	Umin	0.249	0.285	0.243	0.279	0.249	0.281	0.239	0.282
	Umax	2.439	2.440	2.386	2.386	2.452	2.456	2.353	2.376
	Compliance	0.175	0.189	0.174	0.184	0.176	0.178	0.175	0.182
	Compliance_Cycle	0.181		0.179		0.177		0.178	
	Static Energy	15.563		14.769		15.827		14.550	
	Energy Dissipation	2.911		2.804		2.916		2.625	
Sensor 6	Umin	0.345	0.452	0.331	0.422	0.342	0.418	0.331	0.410
	Umax	3.228	3.437	3.206	3.356	3.239	3.444	3.128	3.434
	Compliance	0.235	0.266	0.233	0.258	0.237	0.243	0.237	0.255
	Compliance_Cycle	0.249		0.245		0.240		0.246	
	Static Energy	21.922		20.773		22.193		21.029	
	Energy Dissipation	5.769		5.765		5.780		5.022	
Sensor 7	Umin	0.063	0.065	0.062	0.064	0.063	0.064	0.061	0.065
	Umax	0.418	0.418	0.407	0.407	0.419	0.419	0.402	0.402
	Compliance	0.028	0.030	0.028	0.029	0.028	0.029	0.028	0.029
	Compliance_Cycle	0.029		0.028		0.028		0.028	
	Static Energy	2.667		2.521		2.702		2.459	
	Energy Dissipation	0.423		0.392		0.448		0.407	
Sensor 8	Umin	0.213	0.224	0.206	0.218	0.210	0.219	0.206	0.229
	Umax	2.569	2.569	2.497	2.498	2.578	2.578	2.467	2.467
	Compliance	0.185	0.197	0.183	0.192	0.186	0.190	0.185	0.190
	Compliance_Cycle	0.190		0.188		0.188		0.187	
	Static Energy	16.386		15.462		16.613		15.108	
	Energy Dissipation	2.569		2.466		2.612		2.391	
Sensor 9	Umin	0.337	0.361	0.333	0.354	0.332	0.357	0.331	0.370
	Umax	3.513	3.549	3.442	3.466	3.516	3.572	3.368	3.389
	Compliance	0.250	0.271	0.247	0.265	0.252	0.260	0.251	0.261
	Compliance_Cycle	0.260		0.256		0.256		0.256	
	Static Energy	22.636		21.454		23.018		20.754	
	Energy Dissipation	4.559		4.451		4.660		4.253	
Sensor 10	Umin	0.231	0.240	0.239	0.191	0.197	0.208	0.207	0.211
	Umax	2.155	2.155	2.117	2.117	2.168	2.168	2.078	2.078
	Compliance	0.154	0.163	0.154	0.162	0.154	0.159	0.155	0.159
	Compliance_Cycle	0.159		0.158		0.157		0.157	
	Static Energy	13.745		13.104		13.971		12.725	
	Energy Dissipation	1.669		1.616		1.955		1.654	

Config 3 Series 2 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.60	0.60	0.40	0.40	0.41	0.41	0.42
	Fmax	12.90	12.90	13.01	13.01	13.09	13.09	13.50	13.50
Sensor 1	Umin	-0.001	0.020	0.011	0.013	0.012	0.015	0.012	0.015
	Umax	0.340	0.341	0.340	0.343	0.349	0.349	0.355	0.355
	Compliance	0.027	0.028	0.026	0.028	0.027	0.029	0.027	0.030
	Compliance_Cycle	0.027		0.027		0.028		0.028	
	Static Energy	2.100		2.162		2.211		2.320	
	Energy Dissipation	0.415		0.407		0.393		0.424	
Sensor 2	Umin	-0.008	0.142	0.080	0.119	0.102	0.104	0.097	0.131
	Umax	2.426	2.430	2.418	2.445	2.447	2.455	2.544	2.545
	Compliance	0.187	0.197	0.185	0.199	0.187	0.203	0.187	0.208
	Compliance_Cycle	0.192		0.192		0.194		0.197	
	Static Energy	14.996		15.417		15.568		16.640	
	Energy Dissipation	3.205		3.158		3.205		3.242	
Sensor 3	Umin	-0.001	0.249	0.129	0.275	0.181	0.181	0.163	0.315
	Umax	3.905	4.042	3.835	4.106	3.953	4.100	4.127	4.159
	Compliance	0.306	0.333	0.301	0.333	0.304	0.344	0.307	0.348
	Compliance_Cycle	0.318		0.316		0.323		0.326	
	Static Energy	24.868		25.891		25.999		27.193	
	Energy Dissipation	6.199		6.433		6.613		6.406	
Sensor 4	Umin	-0.002	0.036	0.021	0.025	0.023	0.025	0.024	0.027
	Umax	0.600	0.600	0.600	0.605	0.607	0.608	0.631	0.631
	Compliance	0.045	0.047	0.044	0.048	0.045	0.049	0.045	0.050
	Compliance_Cycle	0.046		0.046		0.047		0.048	
	Static Energy	3.700		3.817		3.857		4.123	
	Energy Dissipation	1.029		0.984		0.979		1.036	
Sensor 5	Umin	-0.001	0.147	0.091	0.127	0.091	0.122	0.110	0.122
	Umax	2.262	2.272	2.230	2.260	2.285	2.297	2.360	2.361
	Compliance	0.176	0.183	0.172	0.182	0.174	0.188	0.174	0.192
	Compliance_Cycle	0.180		0.177		0.181		0.183	
	Static Energy	13.984		14.251		14.566		15.437	
	Energy Dissipation	3.020		2.776		2.836		2.953	
Sensor 6	Umin	-0.028	0.226	0.097	0.242	0.107	0.154	0.130	0.207
	Umax	3.058	3.279	2.851	3.238	3.062	3.302	3.153	3.258
	Compliance	0.239	0.261	0.229	0.254	0.233	0.268	0.234	0.272
	Compliance_Cycle	0.250		0.241		0.249		0.252	
	Static Energy	20.342		20.417		20.938		21.302	
	Energy Dissipation	5.910		5.303		5.569		5.698	
Sensor 7	Umin	-0.001	0.021	0.013	0.015	0.014	0.015	0.014	0.017
	Umax	0.362	0.363	0.362	0.365	0.369	0.369	0.380	0.380
	Compliance	0.027	0.029	0.027	0.029	0.028	0.029	0.028	0.030
	Compliance_Cycle	0.028		0.028		0.029		0.029	
	Static Energy	2.239		2.300		2.339		2.482	
	Energy Dissipation	0.458		0.429		0.417		0.445	
Sensor 8	Umin	-0.010	0.126	0.070	0.087	0.080	0.088	0.086	0.091
	Umax	2.391	2.391	2.387	2.406	2.412	2.415	2.491	2.491
	Compliance	0.183	0.189	0.181	0.191	0.184	0.193	0.184	0.198
	Compliance_Cycle	0.186		0.186		0.188		0.191	
	Static Energy	14.770		15.171		15.314		16.287	
	Energy Dissipation	2.568		2.412		2.482		2.511	
Sensor 9	Umin	-0.031	0.180	0.093	0.127	0.107	0.129	0.119	0.124
	Umax	3.276	3.287	3.207	3.262	3.271	3.310	3.359	3.396
	Compliance	0.251	0.259	0.246	0.262	0.248	0.267	0.250	0.275
	Compliance_Cycle	0.255		0.254		0.257		0.262	
	Static Energy	20.412		20.569		20.989		22.204	
	Energy Dissipation	4.390		4.194		4.386		4.313	
Sensor 10	Umin	-0.004	0.077	0.054	0.065	0.064	0.064	0.064	0.093
	Umax	1.946	1.946	1.938	1.951	2.004	2.004	2.048	2.048
	Compliance	0.151	0.159	0.150	0.158	0.155	0.162	0.154	0.162
	Compliance_Cycle	0.155		0.154		0.158		0.158	
	Static Energy	11.992		12.302		12.708		13.390	
	Energy Dissipation	1.814		1.707		1.667		1.710	

Config 3 Series 2 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.42	0.39	0.39	0.44	0.44	0.47		
	Fmax	12.90	12.90	13.92	13.92	13.17	13.17		
Sensor 1	Umin	0.013	0.014	0.011	0.017	0.013	0.018		
	Umax	0.337	0.337	0.366	0.366	0.346	0.346		
	Compliance	0.027	0.029	0.027	0.029	0.027	0.030		
	Compliance_Cycle	0.028		0.028		0.028			
	Static Energy	2.106		2.463		2.196			
	Energy Dissipation	0.368		0.455		0.376			
Sensor 2	Umin	0.125	0.105	0.097	0.119	0.114	0.133		
	Umax	2.380	2.380	2.607	2.607	2.471	2.471		
	Compliance	0.184	0.204	0.188	0.207	0.187	0.207		
	Compliance_Cycle	0.193		0.197		0.197			
	Static Energy	14.890		17.571		15.685			
	Energy Dissipation	2.864		3.462		2.910			
Sensor 3	Umin	0.302	0.200	0.179	0.226	0.208	0.280		
	Umax	3.738	3.877	4.181	4.310	3.955	4.081		
	Compliance	0.293	0.341	0.309	0.349	0.308	0.347		
	Compliance_Cycle	0.316		0.328		0.326			
	Static Energy	24.256		29.050		25.905			
	Energy Dissipation	5.804		6.719		5.499			
Sensor 4	Umin	0.025	0.024	0.022	0.028	0.027	0.030		
	Umax	0.595	0.595	0.654	0.650	0.610	0.610		
	Compliance	0.045	0.049	0.045	0.050	0.045	0.050		
	Compliance_Cycle	0.047		0.048		0.047			
	Static Energy	3.725		4.407		3.874			
	Energy Dissipation	0.899		1.128		0.949			
Sensor 5	Umin	0.106	0.123	0.090	0.126	0.109	0.152		
	Umax	2.245	2.245	2.418	2.418	2.307	2.308		
	Compliance	0.174	0.189	0.174	0.189	0.175	0.190		
	Compliance_Cycle	0.182		0.181		0.182			
	Static Energy	14.045		16.297		14.651			
	Energy Dissipation	2.576		3.220		2.716			
Sensor 6	Umin	0.127	0.188	0.093	0.149	0.145	0.280		
	Umax	2.996	3.172	3.161	3.394	3.081	3.365		
	Compliance	0.237	0.270	0.231	0.268	0.239	0.269		
	Compliance_Cycle	0.253		0.249		0.253			
	Static Energy	19.845		22.876		21.360			
	Energy Dissipation	4.842		6.318		5.123			
Sensor 7	Umin	0.016	0.014	0.013	0.016	0.016	0.016		
	Umax	0.360	0.360	0.394	0.394	0.371	0.371		
	Compliance	0.027	0.030	0.028	0.030	0.028	0.030		
	Compliance_Cycle	0.028		0.029		0.029			
	Static Energy	2.251		2.654		2.352			
	Energy Dissipation	0.384		0.486		0.411			
Sensor 8	Umin	0.089	0.090	0.081	0.100	0.096	0.107		
	Umax	2.371	2.371	2.572	2.562	2.428	2.428		
	Compliance	0.183	0.194	0.184	0.196	0.183	0.197		
	Compliance_Cycle	0.188		0.190		0.190			
	Static Energy	14.834		17.335		15.412			
	Energy Dissipation	2.274		2.772		2.380			
Sensor 9	Umin	0.121	0.130	0.098	0.142	0.130	0.161		
	Umax	3.215	3.241	3.488	3.507	3.296	3.313		
	Compliance	0.249	0.269	0.249	0.272	0.250	0.273		
	Compliance_Cycle	0.259		0.260		0.261			
	Static Energy	20.277		23.637		21.030			
	Energy Dissipation	3.889		4.920		4.176			
Sensor 10	Umin	0.085	0.077	0.077	0.091	0.086	0.087		
	Umax	1.948	1.951	2.128	2.128	1.996	1.996		
	Compliance	0.152	0.162	0.153	0.163	0.152	0.164		
	Compliance_Cycle	0.157		0.158		0.158			
	Static Energy	12.206		14.343		12.670			
	Energy Dissipation	1.580		1.907		1.599			

Config 3 Series 3 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.31	0.31	0.38	0.38	0.41	0.41	0.44
	Fmax	12.91	12.91	14.62	14.62	12.94	12.94	12.67	12.67
Sensor 1	Umin	-0.001	0.015	0.011	0.014	0.013	0.015	0.010	0.012
	Umax	0.342	0.342	0.387	0.387	0.340	0.340	0.333	0.333
	Compliance	0.028	0.027	0.027	0.029	0.027	0.029	0.027	0.029
	Compliance_Cycle	0.027		0.028		0.028		0.028	
	Static Energy	2.159		2.756		2.129		2.038	
	Energy Dissipation	0.399		0.500		0.379		0.347	
Sensor 2	Umin	0.008	0.114	0.092	0.097	0.091	0.101	0.081	0.100
	Umax	2.411	2.431	2.744	2.755	2.452	2.452	2.378	2.391
	Compliance	0.191	0.194	0.188	0.206	0.190	0.208	0.189	0.202
	Compliance_Cycle	0.192		0.196		0.199		0.195	
	Static Energy	15.311		19.617		15.358		14.624	
	Energy Dissipation	3.133		3.881		2.915		2.717	
Sensor 3	Umin	-0.004	0.276	0.158	0.134	0.123	0.181	0.119	0.155
	Umax	3.850	4.069	4.426	4.573	3.999	4.048	3.863	4.008
	Compliance	0.318	0.323	0.309	0.351	0.318	0.355	0.314	0.344
	Compliance_Cycle	0.320		0.329		0.336		0.329	
	Static Energy	25.652		32.562		25.354		24.514	
	Energy Dissipation	6.215		7.612		5.612		5.168	
Sensor 4	Umin	0.002	0.022	0.021	0.029	0.028	0.031	0.026	0.030
	Umax	0.599	0.599	0.693	0.693	0.601	0.601	0.588	0.588
	Compliance	0.046	0.047	0.046	0.050	0.045	0.049	0.045	0.048
	Compliance_Cycle	0.046		0.048		0.047		0.046	
	Static Energy	3.771		4.934		3.765		3.599	
	Energy Dissipation	1.012		1.288		0.954		0.901	
Sensor 5	Umin	-0.009	0.102	0.065	0.087	0.074	0.114	0.066	0.085
	Umax	2.247	2.256	2.547	2.565	2.258	2.258	2.208	2.216
	Compliance	0.178	0.179	0.174	0.189	0.176	0.190	0.176	0.186
	Compliance_Cycle	0.179		0.181		0.183		0.181	
	Static Energy	14.266		18.264		14.143		13.553	
	Energy Dissipation	2.925		3.548		2.676		2.447	
Sensor 6	Umin	-0.047	0.190	0.066	0.107	0.067	0.130	0.035	0.091
	Umax	2.994	3.217	3.410	3.617	3.034	3.223	2.962	3.102
	Compliance	0.244	0.250	0.233	0.268	0.242	0.270	0.241	0.264
	Compliance_Cycle	0.247		0.249		0.255		0.252	
	Static Energy	20.559		25.754		20.187		18.972	
	Energy Dissipation	5.687		6.627		5.066		4.378	
Sensor 7	Umin	0.001	0.013	0.012	0.015	0.015	0.017	0.015	0.017
	Umax	0.361	0.361	0.415	0.415	0.366	0.366	0.357	0.358
	Compliance	0.028	0.029	0.028	0.030	0.028	0.030	0.028	0.029
	Compliance_Cycle	0.028		0.029		0.029		0.028	
	Static Energy	2.273		2.954		2.290		2.188	
	Energy Dissipation	0.436		0.569		0.414		0.395	
Sensor 8	Umin	0.008	0.078	0.073	0.095	0.091	0.110	0.095	0.110
	Umax	2.376	2.376	2.716	2.717	2.388	2.388	2.349	2.349
	Compliance	0.185	0.188	0.184	0.195	0.184	0.195	0.183	0.190
	Compliance_Cycle	0.186		0.189		0.189		0.187	
	Static Energy	14.965		19.346		14.957		14.367	
	Energy Dissipation	2.519		3.131		2.358		2.233	
Sensor 9	Umin	0.007	0.126	0.112	0.152	0.143	0.184	0.149	0.179
	Umax	3.267	3.277	3.701	3.726	3.285	3.296	3.264	3.273
	Compliance	0.254	0.259	0.250	0.269	0.251	0.272	0.252	0.265
	Compliance_Cycle	0.256		0.259		0.261		0.258	
	Static Energy	20.640		26.531		20.644		20.018	
	Energy Dissipation	4.555		5.741		4.311		3.962	
Sensor 10	Umin	0.000	0.053	0.053	0.070	0.078	0.093	0.092	0.080
	Umax	1.960	1.960	2.256	2.256	2.000	2.000	1.956	1.959
	Compliance	0.155	0.158	0.156	0.164	0.156	0.164	0.154	0.161
	Compliance_Cycle	0.157		0.160		0.160		0.157	
	Static Energy	12.346		16.064		12.527		11.982	
	Energy Dissipation	1.771		2.124		1.639		1.546	

Config 3 Series 3 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.44	0.44	0.44	0.45	0.45	0.45	0.45	0.43
	Fmax	14.26	14.26	13.13	13.13	12.76	12.76	12.74	12.74
Sensor 1	Umin	0.009	0.013	0.011	0.013	0.010	0.013	0.010	0.013
	Umax	0.372	0.372	0.343	0.343	0.328	0.329	0.331	0.331
	Compliance	0.027	0.029	0.027	0.030	0.027	0.029	0.027	0.029
	Compliance_Cycle	0.028		0.028		0.028		0.028	
	Static Energy	2.568		2.172		2.022		2.038	
	Energy Dissipation	0.450		0.398		0.364		0.359	
Sensor 2	Umin	0.086	0.119	0.107	0.106	0.104	0.098	0.090	0.093
	Umax	2.668	2.668	2.455	2.461	2.368	2.369	2.383	2.396
	Compliance	0.190	0.201	0.190	0.208	0.189	0.203	0.188	0.205
	Compliance_Cycle	0.195		0.199		0.196		0.196	
	Static Energy	18.442		15.608		14.581		14.753	
	Energy Dissipation	3.473		2.911		2.725		2.653	
Sensor 3	Umin	0.126	0.251	0.194	0.204	0.143	0.144	0.115	0.134
	Umax	4.301	4.396	3.944	4.069	3.765	3.890	3.859	3.949
	Compliance	0.317	0.337	0.315	0.355	0.310	0.344	0.308	0.350
	Compliance_Cycle	0.327		0.334		0.326		0.328	
	Static Energy	30.387		25.807		23.942		24.315	
	Energy Dissipation	6.607		5.705		5.179		5.105	
Sensor 4	Umin	0.028	0.032	0.032	0.033	0.031	0.032	0.030	0.031
	Umax	0.671	0.671	0.614	0.614	0.588	0.588	0.590	0.590
	Compliance	0.046	0.049	0.045	0.050	0.045	0.048	0.045	0.048
	Compliance_Cycle	0.047		0.047		0.047		0.047	
	Static Energy	4.638		3.895		3.622		3.630	
	Energy Dissipation	1.173		0.958		0.907		0.884	
Sensor 5	Umin	0.063	0.075	0.072	0.090	0.070	0.094	0.066	0.100
	Umax	2.461	2.468	2.278	2.286	2.184	2.187	2.209	2.213
	Compliance	0.176	0.185	0.177	0.191	0.175	0.187	0.177	0.188
	Compliance_Cycle	0.180		0.183		0.181		0.182	
	Static Energy	17.060		14.498		13.461		13.626	
	Energy Dissipation	3.211		2.744		2.614		2.507	
Sensor 6	Umin	0.034	0.078	0.030	0.103	0.047	0.085	0.034	0.131
	Umax	3.255	3.508	3.023	3.199	2.823	3.045	2.939	3.110
	Compliance	0.239	0.262	0.241	0.272	0.237	0.263	0.243	0.268
	Compliance_Cycle	0.250		0.255		0.249		0.255	
	Static Energy	24.249		20.289		18.742		19.149	
	Energy Dissipation	5.998		5.284		5.031		4.685	
Sensor 7	Umin	0.016	0.019	0.019	0.020	0.019	0.019	0.018	0.018
	Umax	0.406	0.406	0.373	0.373	0.359	0.360	0.360	0.360
	Compliance	0.028	0.029	0.028	0.030	0.028	0.030	0.028	0.030
	Compliance_Cycle	0.029		0.029		0.029		0.029	
	Static Energy	2.804		2.364		2.213		2.217	
	Energy Dissipation	0.506		0.417		0.393		0.401	
Sensor 8	Umin	0.102	0.112	0.111	0.111	0.106	0.116	0.106	0.114
	Umax	2.629	2.631	2.434	2.434	2.347	2.349	2.354	2.354
	Compliance	0.184	0.192	0.184	0.196	0.184	0.192	0.183	0.193
	Compliance_Cycle	0.188		0.190		0.188		0.188	
	Static Energy	18.187		15.437		14.458		14.494	
	Energy Dissipation	2.799		2.315		2.253		2.229	
Sensor 9	Umin	0.157	0.183	0.172	0.176	0.160	0.173	0.163	0.179
	Umax	3.572	3.590	3.359	3.369	3.207	3.253	3.252	3.262
	Compliance	0.250	0.265	0.252	0.273	0.251	0.268	0.250	0.268
	Compliance_Cycle	0.257		0.262		0.259		0.259	
	Static Energy	24.816		21.367		20.022		20.085	
	Energy Dissipation	4.817		4.032		4.053		3.963	
Sensor 10	Umin	0.081	0.123	0.119	0.128	0.119	0.102	0.102	0.074
	Umax	2.217	2.217	2.027	2.027	1.949	1.953	1.947	1.950
	Compliance	0.157	0.159	0.152	0.162	0.153	0.162	0.153	0.163
	Compliance_Cycle	0.158		0.157		0.157		0.158	
	Static Energy	15.325		12.856		12.020		12.007	
	Energy Dissipation	1.957		1.696		1.514		1.550	

Config 4 Series 1 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.54	0.54	0.51	0.51	0.50	0.50	0.50
	Fmax	12.84	12.84	12.64	12.64	13.22	13.22	12.90	12.90
Sensor 1	Umin	0.000	0.039	0.036	0.026	0.026	0.032	0.028	0.027
	Umax	0.349	0.349	0.336	0.336	0.351	0.351	0.338	0.338
	Compliance	0.027	0.027	0.025	0.028	0.026	0.026	0.025	0.028
	Compliance_Cycle	0.027		0.026		0.026		0.027	
	Static Energy	2.146		2.035		2.234		2.096	
	Energy Dissipation	0.662		0.475		0.569		0.507	
Sensor 2	Umin	0.006	0.219	0.210	0.182	0.170	0.204	0.196	0.181
	Umax	2.413	2.419	2.340	2.340	2.457	2.487	2.407	2.414
	Compliance	0.183	0.191	0.177	0.193	0.183	0.187	0.183	0.197
	Compliance_Cycle	0.187		0.184		0.185		0.190	
	Static Energy	14.877		14.193		15.813		14.963	
	Energy Dissipation	3.919		3.176		3.494		2.679	
Sensor 3	Umin	0.026	0.453	0.404	0.344	0.334	0.397	0.378	0.315
	Umax	3.902	3.934	3.626	3.917	3.873	4.118	3.824	3.892
	Compliance	0.290	0.314	0.264	0.320	0.292	0.305	0.295	0.331
	Compliance_Cycle	0.301		0.289		0.299		0.312	
	Static Energy	24.194		23.759		26.183		24.124	
	Energy Dissipation	9.618		8.251		8.152		5.360	
Sensor 4	Umin	0.000	0.041	0.040	0.036	0.035	0.039	0.037	0.038
	Umax	0.565	0.565	0.551	0.551	0.578	0.578	0.559	0.559
	Compliance	0.042	0.044	0.042	0.044	0.042	0.043	0.042	0.044
	Compliance_Cycle	0.043		0.043		0.043		0.043	
	Static Energy	3.472		3.344		3.675		3.464	
	Energy Dissipation	0.900		0.727		0.843		0.757	
Sensor 5	Umin	0.000	0.199	0.164	0.179	0.146	0.192	0.168	0.177
	Umax	2.254	2.270	2.215	2.238	2.310	2.324	2.249	2.250
	Compliance	0.172	0.182	0.168	0.182	0.173	0.176	0.173	0.184
	Compliance_Cycle	0.177		0.175		0.175		0.178	
	Static Energy	13.960		13.575		14.776		13.946	
	Energy Dissipation	3.410		3.076		3.087		2.794	
Sensor 6	Umin	-0.011	0.387	0.191	0.200	0.196	0.341	0.208	0.317
	Umax	3.154	3.306	3.042	3.315	3.139	3.320	3.030	3.231
	Compliance	0.234	0.257	0.215	0.262	0.242	0.246	0.242	0.262
	Compliance_Cycle	0.245		0.236		0.244		0.251	
	Static Energy	20.399		20.107		21.109		20.027	
	Energy Dissipation	7.483		7.491		6.324		5.836	
Sensor 7	Umin	0.000	0.023	0.023	0.019	0.018	0.022	0.020	0.021
	Umax	0.360	0.360	0.354	0.354	0.370	0.370	0.360	0.360
	Compliance	0.027	0.028	0.027	0.029	0.028	0.028	0.027	0.029
	Compliance_Cycle	0.028		0.028		0.028		0.028	
	Static Energy	2.211		2.144		2.351		2.234	
	Energy Dissipation	0.424		0.370		0.448		0.397	
Sensor 8	Umin	0.000	0.159	0.156	0.157	0.150	0.171	0.155	0.162
	Umax	2.356	2.362	2.331	2.330	2.439	2.439	2.376	2.376
	Compliance	0.181	0.186	0.180	0.186	0.181	0.183	0.181	0.188
	Compliance_Cycle	0.183		0.183		0.182		0.184	
	Static Energy	14.526		14.139		15.508		14.727	
	Energy Dissipation	2.579		2.182		2.453		2.194	
Sensor 9	Umin	-0.008	0.250	0.231	0.252	0.224	0.280	0.243	0.258
	Umax	3.266	3.310	3.258	3.258	3.396	3.401	3.286	3.295
	Compliance	0.251	0.259	0.249	0.260	0.249	0.255	0.248	0.263
	Compliance_Cycle	0.255		0.254		0.252		0.255	
	Static Energy	20.404		19.761		21.624		20.424	
	Energy Dissipation	4.669		4.056		4.595		3.973	
Sensor 10	Umin	-0.005	0.137	0.137	0.103	0.107	0.123	0.116	0.109
	Umax	1.989	1.990	1.942	1.942	2.049	2.049	1.998	1.998
	Compliance	0.154	0.159	0.152	0.160	0.153	0.159	0.153	0.162
	Compliance_Cycle	0.157		0.156		0.156		0.157	
	Static Energy	12.271		11.779		13.028		12.384	
	Energy Dissipation	1.970		1.531		1.765		1.577	

Config 4 Series 1 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.50	0.48	0.48	0.47	0.47	0.47	0.47	0.49
	Fmax	12.18	12.18	12.74	12.74	12.77	12.77	12.72	12.72
Sensor 1	Umin	0.026	0.029	0.026	0.023	0.022	0.023	0.022	0.024
	Umax	0.319	0.329	0.336	0.336	0.337	0.337	0.335	0.335
	Compliance	0.025	0.026	0.025	0.028	0.026	0.028	0.026	0.027
	Compliance_Cycle	0.026		0.027		0.027		0.026	
	Static Energy	1.922		2.060		2.072		2.045	
	Energy Dissipation	0.481		0.487		0.500		0.481	
Sensor 2	Umin	0.173	0.178	0.175	0.157	0.156	0.182	0.180	0.198
	Umax	2.285	2.336	2.353	2.353	2.383	2.383	2.385	2.385
	Compliance	0.182	0.189	0.181	0.199	0.181	0.194	0.182	0.191
	Compliance_Cycle	0.185		0.189		0.187		0.186	
	Static Energy	13.670		14.441		14.651		14.580	
	Energy Dissipation	2.887		2.652		3.421		3.134	
Sensor 3	Umin	0.296	0.320	0.287	0.248	0.244	0.338	0.332	0.353
	Umax	3.635	3.965	3.627	3.738	3.767	3.865	3.801	3.960
	Compliance	0.290	0.316	0.286	0.333	0.288	0.327	0.295	0.319
	Compliance_Cycle	0.303		0.308		0.306		0.307	
	Static Energy	23.203		22.941		23.763		24.208	
	Energy Dissipation	6.673		5.571		8.569		7.255	
Sensor 4	Umin	0.037	0.037	0.036	0.035	0.034	0.036	0.035	0.037
	Umax	0.522	0.534	0.554	0.551	0.552	0.552	0.550	0.550
	Compliance	0.041	0.042	0.042	0.045	0.041	0.044	0.041	0.043
	Compliance_Cycle	0.042		0.043		0.043		0.042	
	Static Energy	3.125		3.401		3.396		3.360	
	Energy Dissipation	0.695		0.745		0.738		0.734	
Sensor 5	Umin	0.149	0.195	0.161	0.146	0.142	0.183	0.162	0.187
	Umax	2.137	2.183	2.259	2.259	2.251	2.251	2.243	2.250
	Compliance	0.172	0.176	0.171	0.188	0.173	0.183	0.172	0.181
	Compliance_Cycle	0.174		0.179		0.178		0.176	
	Static Energy	12.775		13.864		13.840		13.755	
	Energy Dissipation	2.789		2.768		2.817		2.702	
Sensor 6	Umin	0.190	0.352	0.210	0.205	0.183	0.306	0.212	0.268
	Umax	2.927	3.170	3.172	3.332	3.115	3.279	3.108	3.286
	Compliance	0.235	0.247	0.235	0.271	0.239	0.262	0.240	0.261
	Compliance_Cycle	0.241		0.252		0.250		0.250	
	Static Energy	18.551		20.449		20.160		20.088	
	Energy Dissipation	6.273		5.924		6.212		5.630	
Sensor 7	Umin	0.021	0.022	0.022	0.020	0.019	0.020	0.020	0.022
	Umax	0.340	0.347	0.360	0.358	0.358	0.358	0.358	0.358
	Compliance	0.027	0.028	0.027	0.029	0.027	0.029	0.027	0.028
	Compliance_Cycle	0.028		0.028		0.028		0.028	
	Static Energy	2.029		2.209		2.198		2.185	
	Energy Dissipation	0.368		0.372		0.393		0.394	
Sensor 8	Umin	0.158	0.172	0.160	0.158	0.156	0.169	0.165	0.178
	Umax	2.245	2.289	2.357	2.349	2.371	2.371	2.359	2.358
	Compliance	0.180	0.181	0.180	0.190	0.180	0.187	0.180	0.184
	Compliance_Cycle	0.180		0.185		0.184		0.182	
	Static Energy	13.395		14.465		14.578		14.421	
	Energy Dissipation	2.123		2.195		2.174		2.210	
Sensor 9	Umin	0.236	0.289	0.248	0.255	0.257	0.284	0.270	0.298
	Umax	3.128	3.217	3.303	3.303	3.305	3.305	3.289	3.291
	Compliance	0.247	0.252	0.249	0.268	0.248	0.262	0.248	0.257
	Compliance_Cycle	0.250		0.258		0.255		0.252	
	Static Energy	18.826		20.271		20.320		20.119	
	Energy Dissipation	4.041		4.107		4.013		4.165	
Sensor 10	Umin	0.105	0.114	0.114	0.090	0.095	0.100	0.102	0.112
	Umax	1.911	1.912	1.979	1.979	1.964	1.964	1.963	1.963
	Compliance	0.155	0.157	0.154	0.164	0.154	0.160	0.153	0.158
	Compliance_Cycle	0.156		0.159		0.157		0.155	
	Static Energy	11.189		12.146		12.075		12.000	
	Energy Dissipation	1.449		1.535		1.542		1.547	

Config 4 Series 2 Table A	**Loading / Unloading**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	Fmin	0.00	0.46	0.46	0.47	0.47	0.50	0.50	0.45
	Fmax	13.34	13.34	12.79	12.79	13.49	13.49	15.36	15.36
Sensor 1	**Umin**	0.000	0.022	0.019	0.021	0.019	0.024	0.022	0.025
	Umax	0.349	0.350	0.336	0.336	0.357	0.357	0.412	0.412
	Compliance	0.026	0.029	0.026	0.027	0.026	0.028	0.026	0.027
	Compliance_Cycle	0.027		0.027		0.027		0.027	
	Static Energy	2.253		2.071		2.320		3.068	
	Energy Dissipation	0.607		0.498		0.553		0.693	
Sensor 2	**Umin**	-0.002	0.120	0.106	0.139	0.123	0.137	0.127	0.145
	Umax	2.405	2.405	2.333	2.337	2.500	2.500	2.836	2.849
	Compliance	0.181	0.198	0.182	0.193	0.182	0.195	0.183	0.191
	Compliance_Cycle	0.189		0.187		0.188		0.187	
	Static Energy	15.500		14.390		16.232		21.233	
	Energy Dissipation	3.584		3.323		3.344		4.473	
Sensor 3	**Umin**	-0.008	0.186	0.148	0.237	0.192	0.231	0.183	0.242
	Umax	3.728	3.929	3.632	3.829	4.061	4.147	4.502	4.659
	Compliance	0.285	0.333	0.295	0.325	0.297	0.332	0.300	0.316
	Compliance_Cycle	0.307		0.309		0.314		0.308	
	Static Energy	25.355		23.578		26.925		34.722	
	Energy Dissipation	8.333		7.959		7.556		10.037	
Sensor 4	**Umin**	0.000	0.032	0.030	0.033	0.031	0.035	0.034	0.043
	Umax	0.596	0.596	0.568	0.569	0.603	0.603	0.710	0.710
	Compliance	0.043	0.047	0.043	0.045	0.043	0.045	0.044	0.046
	Compliance_Cycle	0.045		0.044		0.044		0.045	
	Static Energy	3.835		3.501		3.913		5.290	
	Energy Dissipation	0.948		0.770		0.870		1.299	
Sensor 5	**Umin**	-0.022	0.131	0.102	0.137	0.092	0.145	0.117	0.153
	Umax	2.276	2.278	2.214	2.215	2.312	2.321	2.684	2.685
	Compliance	0.172	0.185	0.172	0.180	0.172	0.181	0.172	0.179
	Compliance_Cycle	0.178		0.176		0.177		0.175	
	Static Energy	14.811		13.639		15.070		20.010	
	Energy Dissipation	3.380		2.818		3.079		4.053	
Sensor 6	**Umin**	-0.072	0.191	0.107	0.242	0.093	0.261	0.129	0.288
	Umax	3.067	3.298	3.068	3.164	3.127	3.388	3.671	3.806
	Compliance	0.235	0.263	0.241	0.255	0.238	0.259	0.233	0.250
	Compliance_Cycle	0.248		0.248		0.248		0.241	
	Static Energy	21.707		19.483		21.997		28.365	
	Energy Dissipation	7.458		6.126		6.475		7.967	
Sensor 7	**Umin**	0.000	0.030	0.029	0.033	0.032	0.034	0.033	0.035
	Umax	0.453	0.453	0.440	0.440	0.466	0.466	0.539	0.539
	Compliance	0.033	0.036	0.033	0.034	0.033	0.035	0.033	0.035
	Compliance_Cycle	0.034		0.033		0.034		0.034	
	Static Energy	2.916		2.711		3.026		4.020	
	Energy Dissipation	0.681		0.483		0.543		0.733	
Sensor 8	**Umin**	-0.005	0.110	0.098	0.113	0.103	0.120	0.112	0.121
	Umax	2.413	2.413	2.325	2.324	2.451	2.449	2.827	2.827
	Compliance	0.179	0.191	0.180	0.186	0.180	0.186	0.181	0.186
	Compliance_Cycle	0.185		0.183		0.183		0.184	
	Static Energy	15.575		14.317		15.914		21.069	
	Energy Dissipation	2.666		2.176		2.457		3.372	
Sensor 9	**Umin**	-0.012	0.179	0.148	0.190	0.150	0.194	0.171	0.210
	Umax	3.280	3.292	3.232	3.234	3.378	3.378	3.871	3.891
	Compliance	0.246	0.265	0.248	0.258	0.247	0.257	0.247	0.256
	Compliance_Cycle	0.255		0.253		0.252		0.251	
	Static Energy	21.280		19.914		21.933		28.998	
	Energy Dissipation	4.928		3.900		4.532		6.055	
Sensor 10	**Umin**	0.000	0.096	0.096	0.119	0.111	0.120	0.120	0.121
	Umax	2.041	2.041	1.957	1.957	2.079	2.079	2.379	2.380
	Compliance	0.152	0.162	0.153	0.158	0.153	0.158	0.153	0.158
	Compliance_Cycle	0.157		0.155		0.155		0.155	
	Static Energy	13.146		12.051		13.498		17.737	
	Energy Dissipation	1.923		1.586		1.668		2.386	

Config 4 Series 2 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.45	0.50	0.50	0.48	0.48	0.44	0.44	0.48
	Fmax	14.34	14.34	13.83	13.83	14.87	14.87	14.79	14.79
Sensor 1	Umin	0.023	0.023	0.020	0.024	0.022	0.023	0.022	0.023
	Umax	0.385	0.385	0.367	0.367	0.399	0.399	0.397	0.397
	Compliance	0.026	0.027	0.025	0.029	0.026	0.028	0.026	0.028
	Compliance_Cycle	0.027		0.027		0.027		0.027	
	Static Energy	2.668		2.453		2.876		2.838	
	Energy Dissipation	0.627		0.569		0.650		0.618	
Sensor 2	Umin	0.133	0.162	0.130	0.137	0.125	0.134	0.130	0.117
	Umax	2.625	2.642	2.487	2.488	2.736	2.736	2.667	2.667
	Compliance	0.180	0.190	0.179	0.202	0.181	0.195	0.178	0.194
	Compliance_Cycle	0.185		0.190		0.188		0.186	
	Static Energy	18.287		16.612		19.745		19.082	
	Energy Dissipation	4.131		3.293		4.367		3.537	
Sensor 3	Umin	0.209	0.283	0.202	0.206	0.169	0.208	0.198	0.142
	Umax	4.106	4.331	3.740	3.868	4.331	4.387	4.046	4.123
	Compliance	0.285	0.318	0.286	0.344	0.288	0.328	0.279	0.316
	Compliance_Cycle	0.300		0.312		0.307		0.296	
	Static Energy	29.977		25.826		31.661		29.499	
	Energy Dissipation	10.153		7.250		10.467		7.487	
Sensor 4	Umin	0.042	0.047	0.041	0.046	0.043	0.046	0.045	0.051
	Umax	0.662	0.662	0.633	0.633	0.689	0.689	0.689	0.689
	Compliance	0.043	0.046	0.043	0.047	0.044	0.047	0.043	0.047
	Compliance_Cycle	0.044		0.045		0.045		0.045	
	Static Energy	4.579		4.229		4.974		4.930	
	Energy Dissipation	1.029		0.939		1.129		1.103	
Sensor 5	Umin	0.116	0.148	0.095	0.154	0.124	0.139	0.119	0.146
	Umax	2.499	2.511	2.371	2.374	2.582	2.587	2.558	2.573
	Compliance	0.172	0.180	0.169	0.188	0.172	0.185	0.170	0.185
	Compliance_Cycle	0.176		0.178		0.178		0.177	
	Static Energy	17.380		15.851		18.670		18.409	
	Energy Dissipation	3.513		3.325		3.777		3.670	
Sensor 6	Umin	0.126	0.280	0.069	0.271	0.128	0.173	0.118	0.204
	Umax	3.394	3.596	3.145	3.405	3.484	3.713	3.425	3.757
	Compliance	0.236	0.254	0.225	0.268	0.233	0.264	0.230	0.264
	Compliance_Cycle	0.245		0.245		0.248		0.246	
	Static Energy	24.890		22.735		26.796		26.881	
	Energy Dissipation	7.464		7.341		7.932		7.601	
Sensor 7	Umin	0.033	0.037	0.032	0.037	0.035	0.034	0.034	0.036
	Umax	0.502	0.502	0.481	0.481	0.522	0.522	0.519	0.519
	Compliance	0.033	0.035	0.033	0.036	0.033	0.036	0.033	0.036
	Compliance_Cycle	0.034		0.034		0.034		0.034	
	Static Energy	3.471		3.214		3.769		3.713	
	Energy Dissipation	0.624		0.558		0.662		0.647	
Sensor 8	Umin	0.109	0.133	0.110	0.131	0.115	0.121	0.113	0.127
	Umax	2.631	2.631	2.524	2.524	2.721	2.721	2.709	2.709
	Compliance	0.180	0.186	0.178	0.192	0.180	0.189	0.179	0.189
	Compliance_Cycle	0.183		0.185		0.184		0.184	
	Static Energy	18.211		16.853		19.637		19.382	
	Energy Dissipation	2.806		2.554		2.979		2.942	
Sensor 9	Umin	0.170	0.226	0.151	0.215	0.177	0.198	0.173	0.201
	Umax	3.623	3.639	3.452	3.477	3.731	3.745	3.697	3.721
	Compliance	0.247	0.256	0.243	0.268	0.246	0.261	0.243	0.262
	Compliance_Cycle	0.252		0.255		0.253		0.252	
	Static Energy	25.188		23.216		27.027		26.623	
	Energy Dissipation	5.001		4.700		5.308		5.250	
Sensor 10	Umin	0.121	0.127	0.126	0.123	0.123	0.117	0.123	0.137
	Umax	2.232	2.232	2.144	2.144	2.320	2.320	2.327	2.327
	Compliance	0.152	0.159	0.150	0.163	0.154	0.161	0.153	0.161
	Compliance_Cycle	0.155		0.157		0.157		0.157	
	Static Energy	15.449		14.315		16.743		16.649	
	Energy Dissipation	1.963		1.724		2.021		2.085	

Config 4 Series 3 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.41	0.41	0.49	0.49	0.50	0.50	0.49
	Fmax	12.56	12.56	12.78	12.78	12.79	12.79	12.84	12.84
Sensor 1	Umin	-0.002	0.024	0.021	0.028	0.025	0.029	0.027	0.029
	Umax	0.326	0.337	0.336	0.337	0.340	0.340	0.341	0.342
	Compliance	0.026	0.027	0.025	0.028	0.025	0.029	0.025	0.029
	Compliance_Cycle	0.027		0.027		0.027		0.027	
	Static Energy	2.058		2.069		2.087		2.111	
	Energy Dissipation	0.554		0.507		0.503		0.489	
Sensor 2	Umin	0.004	0.210	0.192	0.239	0.222	0.237	0.231	0.236
	Umax	2.302	2.370	2.465	2.467	2.487	2.489	2.455	2.468
	Compliance	0.184	0.189	0.183	0.201	0.182	0.206	0.182	0.206
	Compliance_Cycle	0.187		0.192		0.194		0.193	
	Static Energy	14.392		15.162		15.294		15.243	
	Energy Dissipation	4.031		2.663		2.713		2.739	
Sensor 3	Umin	0.076	0.552	0.571	0.635	0.597	0.632	0.609	0.628
	Umax	3.489	3.930	4.170	4.363	4.246	4.331	4.103	4.295
	Compliance	0.283	0.297	0.295	0.340	0.293	0.353	0.290	0.354
	Compliance_Cycle	0.290		0.316		0.320		0.319	
	Static Energy	23.865		26.815		26.612		26.528	
	Energy Dissipation	11.185		5.026		5.451		5.540	
Sensor 4	Umin	-0.003	0.033	0.029	0.039	0.035	0.039	0.037	0.039
	Umax	0.555	0.566	0.567	0.567	0.570	0.570	0.570	0.571
	Compliance	0.044	0.045	0.043	0.046	0.042	0.047	0.042	0.047
	Compliance_Cycle	0.044		0.044		0.044		0.044	
	Static Energy	3.452		3.484		3.501		3.524	
	Energy Dissipation	0.842		0.785		0.764		0.758	
Sensor 5	Umin	-0.014	0.136	0.097	0.168	0.126	0.169	0.143	0.157
	Umax	2.131	2.224	2.197	2.200	2.233	2.236	2.199	2.209
	Compliance	0.173	0.181	0.170	0.185	0.170	0.188	0.170	0.189
	Compliance_Cycle	0.177		0.177		0.179		0.179	
	Static Energy	13.592		13.521		13.739		13.644	
	Energy Dissipation	3.002		2.918		2.747		2.677	
Sensor 6	Umin	-0.045	0.218	0.100	0.231	0.157	0.212	0.144	0.205
	Umax	2.804	3.295	2.969	3.222	3.062	3.248	2.924	3.192
	Compliance	0.233	0.256	0.226	0.265	0.230	0.272	0.234	0.275
	Compliance_Cycle	0.244		0.244		0.249		0.253	
	Static Energy	20.284		19.802		19.957		19.715	
	Energy Dissipation	6.222		6.514		5.913		5.609	
Sensor 7	Umin	-0.003	0.022	0.021	0.028	0.026	0.029	0.027	0.029
	Umax	0.419	0.430	0.429	0.429	0.433	0.433	0.433	0.434
	Compliance	0.033	0.034	0.033	0.035	0.032	0.036	0.032	0.036
	Compliance_Cycle	0.034		0.034		0.034		0.034	
	Static Energy	2.628		2.636		2.662		2.678	
	Energy Dissipation	0.539		0.500		0.470		0.467	
Sensor 8	Umin	-0.015	0.117	0.104	0.145	0.128	0.147	0.138	0.145
	Umax	2.288	2.336	2.332	2.333	2.349	2.349	2.343	2.346
	Compliance	0.183	0.187	0.180	0.191	0.179	0.193	0.179	0.193
	Compliance_Cycle	0.185		0.185		0.186		0.186	
	Static Energy	14.276		14.339		14.434		14.490	
	Energy Dissipation	2.370		2.169		2.097		2.078	
Sensor 9	Umin	-0.035	0.177	0.134	0.229	0.180	0.221	0.199	0.224
	Umax	3.095	3.217	3.169	3.202	3.227	3.237	3.173	3.225
	Compliance	0.250	0.257	0.244	0.264	0.244	0.268	0.244	0.268
	Compliance_Cycle	0.254		0.254		0.255		0.255	
	Static Energy	19.746		19.679		19.890		19.919	
	Energy Dissipation	4.170		3.864		3.659		3.715	
Sensor 10	Umin	-0.015	0.099	0.099	0.145	0.144	0.168	0.166	0.168
	Umax	1.913	1.960	1.964	1.964	1.965	1.965	1.971	1.974
	Compliance	0.154	0.158	0.151	0.161	0.148	0.160	0.149	0.161
	Compliance_Cycle	0.156		0.156		0.154		0.155	
	Static Energy	11.992		12.071		12.074		12.192	
	Energy Dissipation	1.812		1.640		1.567		1.501	

Config 4 Series 3 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.49	0.51	0.51	0.49	0.49	0.56	0.56	0.51
	Fmax	13.49	13.49	12.33	12.33	12.87	12.87	12.61	12.61
Sensor 1	Umin	0.026	0.026	0.026	0.029	0.028	0.024	0.020	0.029
	Umax	0.357	0.357	0.327	0.327	0.344	0.344	0.335	0.335
	Compliance	0.025	0.028	0.025	0.027	0.025	0.029	0.026	0.027
	Compliance_Cycle	0.027		0.026		0.027		0.027	
	Static Energy	2.316		1.938		2.120		2.027	
	Energy Dissipation	0.548		0.463		0.460		0.481	
Sensor 2	Umin	0.228	0.235	0.230	0.238	0.231	0.235	0.206	0.228
	Umax	2.574	2.581	2.420	2.421	2.462	2.473	2.415	2.417
	Compliance	0.182	0.202	0.183	0.197	0.181	0.202	0.180	0.195
	Compliance_Cycle	0.192		0.190		0.191		0.187	
	Static Energy	16.754		14.334		15.221		14.626	
	Energy Dissipation	2.875		2.496		2.608		2.562	
Sensor 3	Umin	0.620	0.615	0.611	0.622	0.614	0.586	0.542	0.598
	Umax	4.272	4.533	4.183	4.308	4.125	4.342	4.081	4.280
	Compliance	0.291	0.340	0.295	0.333	0.291	0.344	0.285	0.330
	Compliance_Cycle	0.313		0.313		0.315		0.306	
	Static Energy	29.424		25.506		26.724		25.900	
	Energy Dissipation	5.475		4.975		4.986		5.162	
Sensor 4	Umin	0.036	0.039	0.037	0.040	0.039	0.036	0.029	0.040
	Umax	0.605	0.605	0.548	0.548	0.574	0.574	0.557	0.557
	Compliance	0.043	0.047	0.042	0.045	0.042	0.046	0.043	0.044
	Compliance_Cycle	0.045		0.044		0.044		0.043	
	Static Energy	3.925		3.245		3.530		3.372	
	Energy Dissipation	0.861		0.690		0.745		0.742	
Sensor 5	Umin	0.131	0.134	0.137	0.157	0.149	0.142	0.104	0.162
	Umax	2.345	2.362	2.169	2.170	2.220	2.238	2.181	2.182
	Compliance	0.171	0.187	0.170	0.182	0.171	0.188	0.171	0.181
	Compliance_Cycle	0.179		0.176		0.179		0.176	
	Static Energy	15.332		12.848		13.774		13.204	
	Energy Dissipation	3.009		2.718		2.638		2.686	
Sensor 6	Umin	0.144	0.187	0.175	0.228	0.168	0.212	0.080	0.208
	Umax	3.168	3.386	3.012	3.166	2.963	3.166	2.968	3.152
	Compliance	0.236	0.267	0.230	0.261	0.236	0.269	0.233	0.257
	Compliance_Cycle	0.251		0.244		0.252		0.245	
	Static Energy	21.979		18.744		19.486		19.074	
	Energy Dissipation	6.140		6.428		5.329		5.820	
Sensor 7	Umin	0.028	0.029	0.028	0.029	0.028	0.026	0.023	0.030
	Umax	0.457	0.457	0.418	0.418	0.436	0.437	0.427	0.427
	Compliance	0.032	0.036	0.032	0.034	0.032	0.035	0.033	0.034
	Compliance_Cycle	0.034		0.033		0.034		0.034	
	Static Energy	2.964		2.477		2.687		2.582	
	Energy Dissipation	0.513		0.422		0.459		0.474	
Sensor 8	Umin	0.132	0.136	0.133	0.146	0.141	0.137	0.116	0.149
	Umax	2.467	2.467	2.266	2.266	2.352	2.354	2.306	2.306
	Compliance	0.180	0.192	0.180	0.186	0.179	0.191	0.179	0.185
	Compliance_Cycle	0.186		0.183		0.185		0.182	
	Static Energy	16.014		13.416		14.488		13.955	
	Energy Dissipation	2.320		1.961		2.092		2.098	
Sensor 9	Umin	0.191	0.198	0.182	0.218	0.206	0.216	0.168	0.238
	Umax	3.335	3.373	3.133	3.138	3.199	3.238	3.154	3.173
	Compliance	0.244	0.265	0.245	0.258	0.244	0.265	0.243	0.256
	Compliance_Cycle	0.255		0.252		0.254		0.249	
	Static Energy	21.894		18.579		19.929		19.201	
	Energy Dissipation	4.072		3.461		3.714		3.917	
Sensor 10	Umin	0.166	0.155	0.147	0.160	0.159	0.118	0.071	0.175
	Umax	2.079	2.079	1.923	1.923	1.984	1.984	1.943	1.943
	Compliance	0.149	0.159	0.151	0.158	0.150	0.163	0.153	0.156
	Compliance_Cycle	0.154		0.154		0.156		0.155	
	Static Energy	13.495		11.385		12.211		11.758	
	Energy Dissipation	1.634		1.415		1.620		1.603	

Config 5 Series 1 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.45	0.45	0.47	0.47	0.43	0.43	0.45
	Fmax	13.71	13.71	12.77	12.77	12.47	12.47	12.51	12.51
Sensor 1	Umin	0.000	0.010	0.009	0.008	0.007	0.009	0.006	0.011
	Umax	0.337	0.337	0.311	0.311	0.298	0.298	0.297	0.297
	Compliance	0.025	0.027	0.025	0.027	0.025	0.027	0.024	0.027
	Compliance_Cycle	0.026		0.026		0.026		0.026	
	Static Energy	2.238		1.909		1.795		1.792	
	Energy Dissipation	0.424		0.459		0.429		0.441	
Sensor 2	Umin	-0.002	0.034	0.029	0.047	0.047	0.037	0.019	0.052
	Umax	2.424	2.431	2.249	2.247	2.114	2.114	2.106	2.106
	Compliance	0.173	0.192	0.179	0.191	0.173	0.196	0.173	0.190
	Compliance_Cycle	0.182		0.185		0.184		0.181	
	Static Energy	16.130		13.827		12.724		12.697	
	Energy Dissipation	3.035		3.134		2.963		2.993	
Sensor 3	Umin	-0.009	0.028	0.011	0.066	0.066	0.025	-0.007	0.098
	Umax	3.870	3.930	3.610	3.666	3.142	3.344	3.075	3.253
	Compliance	0.270	0.322	0.288	0.322	0.258	0.334	0.258	0.308
	Compliance_Cycle	0.294		0.304		0.291		0.281	
	Static Energy	26.109		22.538		20.127		19.655	
	Energy Dissipation	8.049		7.538		6.942		6.972	
Sensor 4	Umin	-0.001	0.040	0.039	0.038	0.039	0.036	0.033	0.036
	Umax	0.632	0.632	0.584	0.583	0.564	0.564	0.562	0.562
	Compliance	0.045	0.047	0.044	0.046	0.044	0.047	0.044	0.046
	Compliance_Cycle	0.046		0.045		0.045		0.045	
	Static Energy	4.195		3.589		3.397		3.391	
	Energy Dissipation	1.086		0.776		0.726		0.736	
Sensor 5	Umin	0.000	0.159	0.150	0.146	0.145	0.151	0.120	0.175
	Umax	2.417	2.431	2.236	2.236	2.144	2.144	2.158	2.158
	Compliance	0.173	0.182	0.172	0.182	0.169	0.184	0.168	0.182
	Compliance_Cycle	0.177		0.177		0.176		0.175	
	Static Energy	16.116		13.747		12.904		13.010	
	Energy Dissipation	3.639		2.820		2.640		2.797	
Sensor 6	Umin	-0.014	0.294	0.209	0.212	0.178	0.240	0.157	0.286
	Umax	3.401	3.509	3.122	3.268	2.866	3.009	2.872	3.178
	Compliance	0.237	0.260	0.237	0.263	0.225	0.263	0.217	0.261
	Compliance_Cycle	0.248		0.250		0.242		0.237	
	Static Energy	23.351		20.091		18.110		19.160	
	Energy Dissipation	7.683		6.001		5.483		6.456	
Sensor 7	Umin	-0.001	0.030	0.030	0.032	0.032	0.031	0.030	0.033
	Umax	0.471	0.472	0.438	0.438	0.424	0.424	0.424	0.424
	Compliance	0.034	0.035	0.033	0.035	0.032	0.035	0.032	0.035
	Compliance_Cycle	0.034		0.034		0.034		0.033	
	Static Energy	3.130		2.692		2.551		2.556	
	Energy Dissipation	0.734		0.536		0.488		0.485	
Sensor 8	Umin	-0.002	0.135	0.130	0.139	0.138	0.134	0.123	0.145
	Umax	2.527	2.528	2.359	2.359	2.299	2.299	2.304	2.304
	Compliance	0.183	0.191	0.181	0.190	0.180	0.193	0.180	0.190
	Compliance_Cycle	0.187		0.185		0.186		0.185	
	Static Energy	16.769		14.503		13.837		13.890	
	Energy Dissipation	3.110		2.392		2.226		2.230	
Sensor 9	Umin	-0.005	0.202	0.189	0.204	0.198	0.200	0.177	0.217
	Umax	3.416	3.469	3.220	3.220	3.115	3.125	3.118	3.141
	Compliance	0.247	0.263	0.243	0.262	0.240	0.268	0.242	0.263
	Compliance_Cycle	0.255		0.252		0.253		0.252	
	Static Energy	23.029		19.796		18.808		18.937	
	Energy Dissipation	5.636		4.323		4.126		4.096	
Sensor 10	Umin	-0.001	0.115	0.116	0.128	0.128	0.138	0.137	0.159
	Umax	2.147	2.145	2.009	1.985	1.901	1.901	1.931	1.931
	Compliance	0.155	0.161	0.155	0.160	0.151	0.160	0.153	0.159
	Compliance_Cycle	0.158		0.157		0.155		0.156	
	Static Energy	14.236		12.351		11.442		11.642	
	Energy Dissipation	2.379		1.663		1.560		1.463	

Config 5 Series 1 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.45	0.38	0.38	0.43	0.43	0.43	0.43	0.43
	Fmax	12.69	12.69	13.82	13.82	12.54	12.54	12.92	12.92
Sensor 1	Umin	0.006	0.006	0.005	0.006	0.006	0.006	0.006	0.007
	Umax	0.307	0.307	0.342	0.342	0.309	0.309	0.318	0.318
	Compliance	0.025	0.027	0.025	0.027	0.025	0.028	0.025	0.027
	Compliance_Cycle	0.026		0.026		0.026		0.026	
	Static Energy	1.890		2.289		1.872		1.987	
	Energy Dissipation	0.429		0.512		0.438		0.474	
Sensor 2	Umin	0.036	0.029	0.033	0.045	0.030	0.045	0.043	0.036
	Umax	2.161	2.161	2.437	2.437	2.211	2.200	2.272	2.277
	Compliance	0.174	0.196	0.181	0.190	0.180	0.199	0.181	0.193
	Compliance_Cycle	0.184		0.185		0.189		0.187	
	Static Energy	13.306		16.317		13.393		14.225	
	Energy Dissipation	3.177		3.385		3.232		2.804	
Sensor 3	Umin	0.049	0.070	0.069	0.064	0.033	0.059	0.054	0.050
	Umax	3.238	3.410	3.895	3.934	3.541	3.563	3.667	3.708
	Compliance	0.262	0.331	0.291	0.316	0.289	0.343	0.292	0.329
	Compliance_Cycle	0.293		0.303		0.314		0.309	
	Static Energy	20.996		26.341		21.582		23.164	
	Energy Dissipation	7.703		7.640		7.874		6.292	
Sensor 4	Umin	0.032	0.029	0.029	0.032	0.031	0.030	0.029	0.029
	Umax	0.570	0.570	0.627	0.627	0.562	0.562	0.577	0.577
	Compliance	0.044	0.047	0.045	0.046	0.044	0.047	0.044	0.046
	Compliance_Cycle	0.045		0.045		0.046		0.045	
	Static Energy	3.507		4.198		3.404		3.602	
	Energy Dissipation	0.748		0.928		0.726		0.764	
Sensor 5	Umin	0.131	0.120	0.119	0.154	0.129	0.162	0.157	0.146
	Umax	2.196	2.197	2.392	2.393	2.191	2.194	2.267	2.268
	Compliance	0.169	0.185	0.173	0.178	0.176	0.186	0.173	0.182
	Compliance_Cycle	0.176		0.176		0.181		0.177	
	Static Energy	13.527		16.023		13.290		14.168	
	Energy Dissipation	2.685		3.103		2.570		2.737	
Sensor 6	Umin	0.169	0.189	0.153	0.257	0.160	0.261	0.193	0.244
	Umax	3.011	3.233	3.269	3.404	3.157	3.162	3.166	3.333
	Compliance	0.221	0.268	0.241	0.255	0.253	0.268	0.244	0.264
	Compliance_Cycle	0.242		0.248		0.260		0.253	
	Static Energy	19.906		22.792		19.153		20.821	
	Energy Dissipation	5.949		6.346		5.224		5.849	
Sensor 7	Umin	0.032	0.029	0.030	0.030	0.030	0.030	0.030	0.030
	Umax	0.434	0.434	0.475	0.475	0.433	0.433	0.442	0.442
	Compliance	0.032	0.035	0.033	0.035	0.033	0.036	0.033	0.035
	Compliance_Cycle	0.034		0.034		0.034		0.034	
	Static Energy	2.669		3.179		2.622		2.763	
	Energy Dissipation	0.493		0.598		0.516		0.533	
Sensor 8	Umin	0.132	0.126	0.130	0.141	0.142	0.138	0.140	0.142
	Umax	2.345	2.345	2.539	2.539	2.334	2.334	2.388	2.388
	Compliance	0.180	0.193	0.181	0.188	0.182	0.194	0.181	0.190
	Compliance_Cycle	0.187		0.185		0.188		0.185	
	Static Energy	14.439		17.000		14.138		14.918	
	Energy Dissipation	2.231		2.733		2.218		2.282	
Sensor 9	Umin	0.196	0.204	0.202	0.219	0.216	0.211	0.214	0.215
	Umax	3.203	3.209	3.391	3.479	3.251	3.214	3.254	3.286
	Compliance	0.243	0.268	0.243	0.259	0.249	0.269	0.244	0.262
	Compliance_Cycle	0.255		0.250		0.259		0.253	
	Static Energy	19.758		23.294		19.692		20.528	
	Energy Dissipation	4.043		4.889		4.073		4.066	
Sensor 10	Umin	0.149	0.133	0.134	0.122	0.128	0.128	0.130	0.137
	Umax	1.953	1.953	2.147	2.147	1.985	1.985	2.003	2.003
	Compliance	0.152	0.161	0.153	0.159	0.156	0.163	0.154	0.159
	Compliance_Cycle	0.156		0.156		0.159		0.157	
	Static Energy	12.025		14.376		12.024		12.513	
	Energy Dissipation	1.447		1.793		1.521		1.555	

Config 5 Series 2 Table A	**Loading / Unloading**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	Fmin	0.00	0.48	0.48	0.44	0.44	0.51	0.51	0.49
	Fmax	12.79	12.79	12.61	12.61	13.01	13.01	13.75	13.75
Sensor 1	**Umin**	-0.002	0.013	0.009	0.011	0.011	0.014	0.012	0.017
	Umax	0.315	0.316	0.316	0.316	0.336	0.336	0.360	0.360
	Compliance	0.026	0.027	0.025	0.028	0.026	0.029	0.026	0.029
	Compliance_Cycle	0.026		0.027		0.027		0.028	
	Static Energy	1.956		1.925		2.100		2.386	
	Energy Dissipation	0.482		0.420		0.426		0.486	
Sensor 2	**Umin**	0.026	0.100	0.080	0.098	0.098	0.114	0.110	0.125
	Umax	2.239	2.239	2.265	2.265	2.320	2.320	2.418	2.418
	Compliance	0.181	0.188	0.181	0.200	0.178	0.197	0.176	0.192
	Compliance_Cycle	0.184		0.190		0.187		0.184	
	Static Energy	13.785		13.781		14.497		16.032	
	Energy Dissipation	2.948		3.018		3.173		3.204	
Sensor 3	**Umin**	0.034	0.135	0.101	0.152	0.140	0.178	0.182	0.213
	Umax	3.319	3.525	3.549	3.550	3.556	3.620	3.627	3.910
	Compliance	0.282	0.306	0.294	0.340	0.271	0.328	0.271	0.316
	Compliance_Cycle	0.294		0.315		0.297		0.292	
	Static Energy	21.702		21.599		22.620		25.924	
	Energy Dissipation	6.096		6.889		7.623		7.094	
Sensor 4	**Umin**	0.007	0.028	0.022	0.024	0.024	0.025	0.024	0.027
	Umax	0.568	0.568	0.558	0.557	0.580	0.579	0.616	0.616
	Compliance	0.045	0.046	0.044	0.048	0.044	0.048	0.044	0.047
	Compliance_Cycle	0.045		0.046		0.046		0.046	
	Static Energy	3.498		3.394		3.621		4.085	
	Energy Dissipation	0.836		0.736		0.784		0.899	
Sensor 5	**Umin**	0.031	0.112	0.080	0.096	0.096	0.103	0.104	0.152
	Umax	2.170	2.171	2.153	2.153	2.271	2.271	2.382	2.382
	Compliance	0.174	0.179	0.172	0.187	0.170	0.186	0.171	0.183
	Compliance_Cycle	0.176		0.179		0.178		0.177	
	Static Energy	13.366		13.099		14.191		15.793	
	Energy Dissipation	2.903		2.625		2.963		3.016	
Sensor 6	**Umin**	0.003	0.182	0.103	0.141	0.125	0.126	0.135	0.248
	Umax	2.938	3.165	2.975	3.153	3.239	3.299	3.280	3.397
	Compliance	0.238	0.255	0.240	0.272	0.225	0.270	0.237	0.260
	Compliance_Cycle	0.246		0.255		0.246		0.248	
	Static Energy	19.485		19.184		20.614		22.522	
	Energy Dissipation	5.909		5.535		7.017		5.960	
Sensor 7	**Umin**	0.007	0.019	0.016	0.015	0.017	0.017	0.016	0.020
	Umax	0.420	0.420	0.415	0.415	0.434	0.434	0.462	0.462
	Compliance	0.033	0.034	0.033	0.035	0.033	0.036	0.033	0.035
	Compliance_Cycle	0.034		0.034		0.034		0.034	
	Static Energy	2.585		2.527		2.714		3.060	
	Energy Dissipation	0.566		0.486		0.535		0.635	
Sensor 8	**Umin**	0.044	0.107	0.090	0.100	0.105	0.113	0.111	0.120
	Umax	2.314	2.314	2.283	2.280	2.373	2.372	2.507	2.507
	Compliance	0.183	0.188	0.180	0.194	0.181	0.194	0.180	0.191
	Compliance_Cycle	0.186		0.187		0.187		0.186	
	Static Energy	14.246		13.890		14.828		16.622	
	Energy Dissipation	2.448		2.200		2.325		2.564	
Sensor 9	**Umin**	0.064	0.160	0.131	0.148	0.151	0.164	0.167	0.189
	Umax	3.118	3.148	3.080	3.091	3.244	3.255	3.393	3.436
	Compliance	0.248	0.260	0.244	0.270	0.246	0.268	0.244	0.264
	Compliance_Cycle	0.254		0.256		0.257		0.253	
	Static Energy	19.381		18.807		20.339		22.781	
	Energy Dissipation	4.409		3.985		4.023		4.601	
Sensor 10	**Umin**	0.012	0.067	0.066	0.085	0.085	0.069	0.089	0.097
	Umax	1.912	1.912	1.909	1.909	1.974	1.974	2.140	2.105
	Compliance	0.155	0.158	0.152	0.162	0.153	0.163	0.155	0.161
	Compliance_Cycle	0.157		0.157		0.158		0.158	
	Static Energy	11.771		11.615		12.335		14.188	
	Energy Dissipation	1.589		1.483		1.705		1.748	

Config 5 Series 2 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.49	0.48	0.48	0.45	0.45	0.55	0.55	0.56
	Fmax	15.07	15.07	12.70	12.70	12.60	12.60	13.55	13.55
Sensor 1	Umin	0.015	0.017	0.016	0.018	0.017	0.022	0.020	0.021
	Umax	0.407	0.408	0.331	0.331	0.335	0.335	0.368	0.368
	Compliance	0.027	0.030	0.026	0.027	0.026	0.028	0.026	0.029
	Compliance_Cycle	0.029		0.027		0.027		0.028	
	Static Energy	2.973		2.027		2.015		2.390	
	Energy Dissipation	0.572		0.421		0.395		0.472	
Sensor 2	Umin	0.115	0.115	0.110	0.103	0.098	0.136	0.123	0.126
	Umax	2.683	2.683	2.290	2.290	2.212	2.212	2.439	2.439
	Compliance	0.179	0.195	0.179	0.188	0.178	0.189	0.178	0.192
	Compliance_Cycle	0.186		0.183		0.183		0.185	
	Static Energy	19.575		14.029		13.326		15.837	
	Energy Dissipation	3.898		2.945		3.167		3.433	
Sensor 3	Umin	0.169	0.181	0.150	0.122	0.121	0.221	0.177	0.180
	Umax	4.139	4.216	3.590	3.656	3.276	3.587	3.822	3.963
	Compliance	0.284	0.322	0.287	0.312	0.282	0.313	0.284	0.323
	Compliance_Cycle	0.302		0.299		0.296		0.302	
	Static Energy	30.759		22.397		21.610		25.733	
	Energy Dissipation	8.287		6.552		7.510		8.102	
Sensor 4	Umin	0.026	0.028	0.028	0.024	0.023	0.030	0.026	0.028
	Umax	0.686	0.686	0.562	0.562	0.555	0.555	0.604	0.604
	Compliance	0.045	0.048	0.043	0.045	0.043	0.045	0.043	0.046
	Compliance_Cycle	0.046		0.044		0.044		0.045	
	Static Energy	5.005		3.442		3.341		3.923	
	Energy Dissipation	1.131		0.735		0.727		0.856	
Sensor 5	Umin	0.111	0.147	0.138	0.123	0.106	0.167	0.124	0.160
	Umax	2.600	2.601	2.190	2.197	2.125	2.125	2.337	2.337
	Compliance	0.171	0.185	0.170	0.180	0.170	0.179	0.170	0.181
	Compliance_Cycle	0.177		0.175		0.174		0.175	
	Static Energy	18.977		13.459		12.802		15.175	
	Energy Dissipation	3.564		2.645		2.615		2.935	
Sensor 6	Umin	0.158	0.217	0.164	0.190	0.116	0.232	0.158	0.250
	Umax	3.541	3.720	3.081	3.258	2.750	3.107	3.208	3.393
	Compliance	0.233	0.264	0.237	0.263	0.227	0.257	0.236	0.258
	Compliance_Cycle	0.247		0.249		0.241		0.246	
	Static Energy	27.141		19.959		18.718		22.032	
	Energy Dissipation	6.946		5.553		5.497		6.146	
Sensor 7	Umin	0.020	0.020	0.019	0.019	0.019	0.022	0.020	0.022
	Umax	0.512	0.512	0.422	0.422	0.417	0.417	0.455	0.455
	Compliance	0.033	0.036	0.032	0.034	0.032	0.034	0.032	0.035
	Compliance_Cycle	0.035		0.033		0.033		0.034	
	Static Energy	3.736		2.588		2.512		2.953	
	Energy Dissipation	0.707		0.534		0.490		0.592	
Sensor 8	Umin	0.114	0.116	0.114	0.104	0.105	0.134	0.125	0.131
	Umax	2.753	2.753	2.311	2.311	2.293	2.293	2.468	2.468
	Compliance	0.181	0.193	0.180	0.186	0.180	0.187	0.179	0.188
	Compliance_Cycle	0.187		0.183		0.184		0.184	
	Static Energy	20.085		14.158		13.814		16.026	
	Energy Dissipation	3.141		2.207		2.198		2.487	
Sensor 9	Umin	0.169	0.176	0.170	0.164	0.160	0.207	0.188	0.203
	Umax	3.702	3.729	3.175	3.179	3.130	3.130	3.333	3.362
	Compliance	0.245	0.266	0.244	0.256	0.245	0.258	0.243	0.259
	Compliance_Cycle	0.255		0.250		0.251		0.251	
	Static Energy	27.206		19.475		18.856		21.831	
	Energy Dissipation	5.411		3.943		3.990		4.419	
Sensor 10	Umin	0.100	0.079	0.092	0.113	0.110	0.093	0.093	0.087
	Umax	2.337	2.337	1.916	1.916	1.902	1.902	2.083	2.083
	Compliance	0.155	0.163	0.153	0.154	0.151	0.159	0.152	0.160
	Compliance_Cycle	0.159		0.153		0.154		0.156	
	Static Energy	17.050		11.738		11.458		13.526	
	Energy Dissipation	2.058		1.483		1.436		1.751	

Config 5 Series 3 Table A	**Loading / Unloading**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	Fmin	0.00	0.06	0.06	0.45	0.45	0.46	0.46	0.44
	Fmax	12.62	12.62	12.81	12.81	12.68	12.68	12.54	12.54
Sensor 1	**Umin**	0.000	0.035	0.033	0.043	0.041	0.051	0.049	0.043
	Umax	0.329	0.330	0.333	0.333	0.347	0.347	0.333	0.334
	Compliance	0.026	0.027	0.024	0.028	0.025	0.027	0.026	0.027
	Compliance_Cycle	0.026		0.026		0.026		0.026	
	Static Energy	2.070		2.056		2.119		2.020	
	Energy Dissipation	0.710		0.581		0.550		0.467	
Sensor 2	**Umin**	0.000	0.051	0.049	0.133	0.134	0.162	0.160	0.112
	Umax	2.358	2.358	2.387	2.388	2.377	2.379	2.342	2.353
	Compliance	0.185	0.203	0.185	0.205	0.185	0.200	0.186	0.197
	Compliance_Cycle	0.194		0.194		0.192		0.191	
	Static Energy	14.813		14.761		14.533		14.236	
	Energy Dissipation	3.534		3.096		3.060		2.756	
Sensor 3	**Umin**	-0.007	0.005	-0.009	0.131	0.119	0.252	0.240	0.081
	Umax	3.884	3.948	3.898	3.991	3.923	4.116	3.850	3.959
	Compliance	0.299	0.358	0.315	0.363	0.317	0.354	0.318	0.347
	Compliance_Cycle	0.326		0.337		0.334		0.332	
	Static Energy	24.846		24.722		25.145		23.952	
	Energy Dissipation	7.536		6.006		6.482		5.332	
Sensor 4	**Umin**	0.000	0.020	0.020	0.040	0.040	0.042	0.043	0.036
	Umax	0.578	0.578	0.587	0.587	0.579	0.579	0.571	0.575
	Compliance	0.045	0.047	0.044	0.048	0.044	0.046	0.044	0.046
	Compliance_Cycle	0.046		0.046		0.045		0.045	
	Static Energy	3.630		3.626		3.539		3.477	
	Energy Dissipation	0.896		0.869		0.803		0.768	
Sensor 5	**Umin**	0.000	0.041	0.040	0.108	0.114	0.125	0.123	0.104
	Umax	2.160	2.161	2.161	2.163	2.149	2.156	2.178	2.197
	Compliance	0.168	0.183	0.170	0.185	0.168	0.180	0.173	0.180
	Compliance_Cycle	0.175		0.177		0.174		0.176	
	Static Energy	13.574		13.370		13.171		13.292	
	Energy Dissipation	3.226		2.596		2.526		2.338	
Sensor 6	**Umin**	-0.006	0.034	0.004	0.096	0.104	0.132	0.117	0.093
	Umax	2.976	3.092	2.802	2.961	2.748	3.059	2.990	3.184
	Compliance	0.220	0.262	0.231	0.262	0.217	0.255	0.245	0.256
	Compliance_Cycle	0.239		0.245		0.235		0.250	
	Static Energy	19.459		18.302		18.687		19.263	
	Energy Dissipation	7.076		4.332		4.783		4.185	
Sensor 7	**Umin**	0.000	0.011	0.011	0.025	0.024	0.028	0.028	0.022
	Umax	0.425	0.425	0.430	0.430	0.427	0.427	0.422	0.425
	Compliance	0.033	0.035	0.032	0.036	0.033	0.034	0.032	0.035
	Compliance_Cycle	0.034		0.034		0.033		0.034	
	Static Energy	2.670		2.658		2.607		2.574	
	Energy Dissipation	0.589		0.574		0.541		0.503	
Sensor 8	**Umin**	0.000	0.057	0.057	0.132	0.130	0.143	0.141	0.125
	Umax	2.314	2.314	2.344	2.344	2.318	2.318	2.288	2.300
	Compliance	0.183	0.189	0.180	0.191	0.181	0.186	0.181	0.185
	Compliance_Cycle	0.186		0.185		0.183		0.183	
	Static Energy	14.535		14.489		14.161		13.915	
	Energy Dissipation	2.411		2.335		2.128		2.110	
Sensor 9	**Umin**	-0.006	0.092	0.083	0.180	0.189	0.213	0.216	0.186
	Umax	3.179	3.181	3.198	3.213	3.189	3.190	3.133	3.171
	Compliance	0.252	0.264	0.246	0.267	0.247	0.258	0.247	0.257
	Compliance_Cycle	0.258		0.256		0.252		0.252	
	Static Energy	20.017		19.860		19.488		19.185	
	Energy Dissipation	4.485		4.343		3.922		4.001	
Sensor 10	**Umin**	0.000	0.041	0.045	0.077	0.097	0.112	0.112	0.088
	Umax	1.934	1.934	1.954	1.955	1.948	1.950	1.947	1.949
	Compliance	0.153	0.161	0.151	0.163	0.152	0.159	0.152	0.159
	Compliance_Cycle	0.157		0.157		0.155		0.156	
	Static Energy	12.148		12.084		11.913		11.792	
	Energy Dissipation	2.019		1.757		1.708		1.598	

Config 5 Series 3 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.44	0.49	0.49	0.33	0.33	0.40	0.40	0.45
	Fmax	12.99	12.99	12.93	12.93	12.50	12.50	12.35	12.35
Sensor 1	Umin	0.043	0.047	0.046	0.044	0.040	0.046	0.035	0.049
	Umax	0.349	0.349	0.342	0.343	0.335	0.335	0.332	0.333
	Compliance	0.026	0.025	0.025	0.027	0.026	0.028	0.026	0.026
	Compliance_Cycle	0.025		0.026		0.027		0.026	
	Static Energy	2.182		2.159		2.025		1.978	
	Energy Dissipation	0.536		0.522		0.497		0.471	
Sensor 2	Umin	0.114	0.158	0.144	0.124	0.109	0.139	0.107	0.147
	Umax	2.439	2.449	2.410	2.410	2.356	2.358	2.343	2.346
	Compliance	0.187	0.193	0.184	0.201	0.187	0.204	0.189	0.197
	Compliance_Cycle	0.190		0.192		0.195		0.193	
	Static Energy	15.302		15.185		14.268		13.959	
	Energy Dissipation	3.012		3.025		2.834		2.504	
Sensor 3	Umin	0.096	0.248	0.182	0.133	0.102	0.138	0.098	0.163
	Umax	4.060	4.209	3.942	4.154	3.915	4.002	3.977	4.101
	Compliance	0.323	0.339	0.313	0.356	0.321	0.361	0.332	0.344
	Compliance_Cycle	0.331		0.333		0.340		0.338	
	Static Energy	26.299		26.173		24.215		24.401	
	Energy Dissipation	5.870		6.078		5.511		4.173	
Sensor 4	Umin	0.036	0.042	0.041	0.034	0.030	0.040	0.025	0.042
	Umax	0.591	0.591	0.585	0.585	0.565	0.565	0.552	0.553
	Compliance	0.044	0.045	0.043	0.046	0.044	0.046	0.044	0.045
	Compliance_Cycle	0.044		0.045		0.045		0.044	
	Static Energy	3.691		3.687		3.420		3.292	
	Energy Dissipation	0.836		0.793		0.771		0.773	
Sensor 5	Umin	0.101	0.138	0.114	0.105	0.084	0.115	0.079	0.133
	Umax	2.240	2.252	2.206	2.206	2.169	2.171	2.155	2.162
	Compliance	0.173	0.177	0.171	0.181	0.174	0.184	0.174	0.180
	Compliance_Cycle	0.175		0.176		0.179		0.177	
	Static Energy	14.071		13.899		13.136		12.864	
	Energy Dissipation	2.580		2.444		2.359		2.368	
Sensor 6	Umin	0.080	0.185	0.100	0.104	0.057	0.108	0.050	0.138
	Umax	3.063	3.191	2.914	3.049	2.955	3.097	2.996	3.132
	Compliance	0.242	0.254	0.237	0.257	0.242	0.266	0.245	0.259
	Compliance_Cycle	0.248		0.247		0.254		0.252	
	Static Energy	19.938		19.211		18.739		18.636	
	Energy Dissipation	4.701		4.246		4.169		4.336	
Sensor 7	Umin	0.022	0.029	0.027	0.023	0.021	0.027	0.022	0.027
	Umax	0.440	0.441	0.435	0.435	0.421	0.422	0.417	0.418
	Compliance	0.033	0.034	0.032	0.035	0.033	0.035	0.033	0.034
	Compliance_Cycle	0.034		0.033		0.034		0.034	
	Static Energy	2.752		2.743		2.550		2.489	
	Energy Dissipation	0.578		0.540		0.515		0.497	
Sensor 8	Umin	0.119	0.152	0.137	0.120	0.098	0.136	0.099	0.148
	Umax	2.376	2.376	2.350	2.350	2.284	2.284	2.247	2.247
	Compliance	0.181	0.183	0.180	0.186	0.182	0.189	0.182	0.184
	Compliance_Cycle	0.182		0.183		0.185		0.183	
	Static Energy	14.846		14.807		13.820		13.370	
	Energy Dissipation	2.275		2.250		2.179		2.127	
Sensor 9	Umin	0.162	0.236	0.171	0.177	0.153	0.205	0.160	0.213
	Umax	3.269	3.288	3.193	3.215	3.153	3.160	3.132	3.132
	Compliance	0.247	0.254	0.244	0.259	0.247	0.264	0.249	0.257
	Compliance_Cycle	0.251		0.251		0.255		0.253	
	Static Energy	20.544		20.257		19.120		18.636	
	Energy Dissipation	4.169		4.207		3.915		3.976	
Sensor 10	Umin	0.091	0.112	0.100	0.091	0.079	0.111	0.081	0.094
	Umax	2.025	2.025	1.986	1.986	1.916	1.916	1.956	1.961
	Compliance	0.155	0.158	0.152	0.159	0.152	0.161	0.156	0.160
	Compliance_Cycle	0.157		0.155		0.157		0.158	
	Static Energy	12.653		12.513		11.593		11.668	
	Energy Dissipation	1.753		1.641		1.528		1.514	

Config 6 Series 1 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.34	0.34	0.37	0.37	0.36	0.36	0.41
	Fmax	13.61	13.61	13.27	13.27	12.69	12.69	12.43	12.43
Sensor 1	Umin	0.002	0.075	0.070	0.075	0.074	0.076	0.074	0.078
	Umax	0.410	0.410	0.401	0.401	0.383	0.383	0.377	0.377
	Compliance	0.031	0.029	0.027	0.026	0.027	0.027	0.027	0.028
	Compliance_Cycle	0.030		0.027		0.027		0.027	
	Static Energy	2.722		2.590		2.364		2.267	
	Energy Dissipation	0.637		0.547		0.487		0.474	
Sensor 2	Umin	-0.002	0.219	0.191	0.214	0.208	0.226	0.215	0.222
	Umax	2.922	2.923	2.859	2.869	2.747	2.747	2.689	2.690
	Compliance	0.214	0.225	0.209	0.216	0.210	0.220	0.209	0.226
	Compliance_Cycle	0.219		0.212		0.215		0.217	
	Static Energy	19.404		18.512		16.935		16.163	
	Energy Dissipation	4.634		3.354		2.986		2.837	
Sensor 3	Umin	-0.001	0.327	0.203	0.278	0.250	0.339	0.267	0.290
	Umax	4.992	5.131	4.896	5.023	4.713	4.829	4.614	4.713
	Compliance	0.367	0.400	0.374	0.387	0.375	0.391	0.374	0.407
	Compliance_Cycle	0.383		0.380		0.383		0.390	
	Static Energy	34.048		32.410		29.771		28.319	
	Energy Dissipation	8.246		5.504		4.594		4.604	
Sensor 4	Umin	-0.001	0.055	0.052	0.056	0.055	0.055	0.054	0.055
	Umax	0.660	0.660	0.642	0.642	0.608	0.608	0.591	0.591
	Compliance	0.048	0.048	0.045	0.046	0.045	0.047	0.045	0.047
	Compliance_Cycle	0.048		0.046		0.046		0.046	
	Static Energy	4.385		4.140		3.747		3.549	
	Energy Dissipation	1.162		0.882		0.772		0.723	
Sensor 5	Umin	0.001	0.234	0.213	0.231	0.235	0.242	0.237	0.258
	Umax	2.786	2.786	2.698	2.731	2.623	2.623	2.508	2.508
	Compliance	0.203	0.208	0.191	0.202	0.193	0.204	0.190	0.206
	Compliance_Cycle	0.205		0.196		0.198		0.198	
	Static Energy	18.485		17.621		16.171		15.070	
	Energy Dissipation	4.686		3.690		3.139		2.941	
Sensor 6	Umin	-0.004	0.389	0.319	0.339	0.360	0.402	0.369	0.400
	Umax	3.995	4.106	3.717	4.062	3.814	3.991	3.402	3.613
	Compliance	0.290	0.309	0.254	0.296	0.271	0.303	0.255	0.302
	Compliance_Cycle	0.299		0.274		0.286		0.277	
	Static Energy	27.272		26.209		24.604		21.709	
	Energy Dissipation	9.873		8.983		6.923		6.442	
Sensor 7	Umin	0.000	0.041	0.039	0.043	0.043	0.044	0.044	0.047
	Umax	0.502	0.502	0.493	0.493	0.472	0.472	0.461	0.461
	Compliance	0.036	0.037	0.035	0.036	0.035	0.036	0.035	0.037
	Compliance_Cycle	0.037		0.035		0.036		0.036	
	Static Energy	3.328		3.184		2.909		2.770	
	Energy Dissipation	0.775		0.578		0.519		0.485	
Sensor 8	Umin	0.004	0.222	0.212	0.229	0.225	0.234	0.232	0.258
	Umax	2.911	2.911	2.865	2.865	2.750	2.750	2.691	2.691
	Compliance	0.212	0.215	0.206	0.210	0.207	0.212	0.206	0.215
	Compliance_Cycle	0.214		0.208		0.210		0.211	
	Static Energy	19.314		18.486		16.954		16.169	
	Energy Dissipation	3.891		2.992		2.723		2.527	
Sensor 9	Umin	0.006	0.376	0.341	0.379	0.371	0.399	0.378	0.435
	Umax	4.098	4.150	4.055	4.102	3.880	3.908	3.792	3.804
	Compliance	0.298	0.309	0.286	0.300	0.288	0.303	0.287	0.308
	Compliance_Cycle	0.304		0.293		0.295		0.297	
	Static Energy	27.535		26.467		24.093		22.857	
	Energy Dissipation	8.078		6.504		5.670		5.040	
Sensor 10	Umin	0.000	0.154	0.154	0.177	0.176	0.177	0.179	0.191
	Umax	2.372	2.372	2.306	2.306	2.215	2.215	2.149	2.150
	Compliance	0.174	0.177	0.166	0.172	0.168	0.174	0.166	0.175
	Compliance_Cycle	0.175		0.169		0.171		0.170	
	Static Energy	15.738		14.879		13.655		12.919	
	Energy Dissipation	3.428		2.196		1.852		1.740	

Config 6 Series 1 Table B	**Loading / Unloading**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
	Fmin	0.41	0.44	0.44	0.42	0.42	0.47	0.47	0.44
	Fmax	12.56	12.56	12.49	12.49	13.19	13.19	13.14	13.14
Sensor 1	**Umin**	0.075	0.081	0.079	0.078	0.077	0.085	0.081	0.086
	Umax	0.379	0.380	0.380	0.380	0.397	0.398	0.400	0.401
	Compliance	0.026	0.028	0.026	0.028	0.026	0.028	0.026	0.028
	Compliance_Cycle	0.027		0.027		0.027		0.027	
	Static Energy	2.301		2.296		2.529		2.544	
	Energy Dissipation	0.463		0.474		0.516		0.513	
Sensor 2	**Umin**	0.215	0.239	0.229	0.216	0.212	0.254	0.228	0.264
	Umax	2.719	2.719	2.703	2.704	2.836	2.841	2.848	2.848
	Compliance	0.209	0.222	0.207	0.222	0.208	0.223	0.207	0.221
	Compliance_Cycle	0.215		0.214		0.215		0.214	
	Static Energy	16.473		16.324		18.064		18.089	
	Energy Dissipation	2.917		2.850		3.155		3.157	
Sensor 3	**Umin**	0.256	0.332	0.275	0.254	0.233	0.366	0.261	0.412
	Umax	4.660	4.756	4.642	4.767	4.873	4.964	4.911	4.957
	Compliance	0.370	0.399	0.368	0.395	0.372	0.399	0.370	0.391
	Compliance_Cycle	0.384		0.381		0.385		0.380	
	Static Energy	28.814		28.779		31.564		31.484	
	Energy Dissipation	4.863		4.984		5.253		5.348	
Sensor 4	**Umin**	0.053	0.057	0.056	0.050	0.050	0.058	0.055	0.057
	Umax	0.596	0.596	0.592	0.592	0.626	0.626	0.625	0.624
	Compliance	0.045	0.047	0.044	0.047	0.045	0.047	0.044	0.047
	Compliance_Cycle	0.046		0.045		0.046		0.045	
	Static Energy	3.611		3.572		3.982		3.967	
	Energy Dissipation	0.741		0.710		0.845		0.817	
Sensor 5	**Umin**	0.242	0.266	0.257	0.243	0.246	0.279	0.261	0.293
	Umax	2.544	2.544	2.558	2.558	2.699	2.702	2.722	2.722
	Compliance	0.192	0.205	0.190	0.205	0.193	0.207	0.192	0.204
	Compliance_Cycle	0.198		0.197		0.199		0.198	
	Static Energy	15.413		15.443		17.181		17.289	
	Energy Dissipation	2.903		2.753		3.055		3.136	
Sensor 6	**Umin**	0.369	0.425	0.398	0.380	0.399	0.443	0.395	0.520
	Umax	3.485	3.821	3.627	3.699	3.885	3.958	3.993	4.081
	Compliance	0.271	0.302	0.262	0.302	0.275	0.308	0.275	0.303
	Compliance_Cycle	0.286		0.281		0.291		0.288	
	Static Energy	23.150		22.331		25.167		25.920	
	Energy Dissipation	5.989		5.695		5.774		6.517	
Sensor 7	**Umin**	0.046	0.050	0.049	0.047	0.047	0.052	0.049	0.053
	Umax	0.468	0.468	0.465	0.465	0.491	0.491	0.492	0.491
	Compliance	0.035	0.036	0.034	0.036	0.035	0.037	0.034	0.036
	Compliance_Cycle	0.036		0.035		0.036		0.035	
	Static Energy	2.833		2.805		3.123		3.122	
	Energy Dissipation	0.502		0.476		0.538		0.533	
Sensor 8	**Umin**	0.248	0.265	0.260	0.246	0.246	0.282	0.265	0.293
	Umax	2.724	2.724	2.714	2.714	2.853	2.853	2.863	2.863
	Compliance	0.205	0.214	0.205	0.214	0.205	0.216	0.204	0.213
	Compliance_Cycle	0.210		0.209		0.210		0.209	
	Static Energy	16.503		16.385		18.141		18.184	
	Energy Dissipation	2.511		2.494		2.885		2.804	
Sensor 9	**Umin**	0.397	0.443	0.427	0.413	0.408	0.477	0.423	0.514
	Umax	3.833	3.858	3.857	3.864	4.016	4.066	4.083	4.083
	Compliance	0.287	0.305	0.286	0.305	0.285	0.308	0.285	0.302
	Compliance_Cycle	0.296		0.295		0.296		0.293	
	Static Energy	23.374		23.327		25.854		25.933	
	Energy Dissipation	5.307		5.070		5.859		5.590	
Sensor 10	**Umin**	0.188	0.211	0.206	0.212	0.210	0.205	0.196	0.240
	Umax	2.176	2.181	2.171	2.172	2.312	2.316	2.308	2.308
	Compliance	0.166	0.175	0.165	0.173	0.166	0.176	0.165	0.173
	Compliance_Cycle	0.170		0.169		0.171		0.169	
	Static Energy	13.214		13.112		14.726		14.659	
	Energy Dissipation	1.789		1.698		1.887		1.990	

Config 6 Series 2 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.65	0.65	0.69	0.69	0.68	0.68	0.40
	Fmax	12.78	12.78	12.69	12.69	12.85	12.85	12.96	12.96
Sensor 1	Umin	0.000	0.035	0.030	0.039	0.035	0.045	0.035	0.044
	Umax	0.340	0.342	0.339	0.339	0.345	0.345	0.347	0.348
	Compliance	0.028	0.029	0.025	0.029	0.025	0.029	0.025	0.027
	Compliance_Cycle	0.028		0.027		0.027		0.026	
	Static Energy	2.072		2.034		2.100		2.183	
	Energy Dissipation	0.608		0.536		0.527		0.605	
Sensor 2	Umin	0.002	0.194	0.135	0.213	0.157	0.271	0.159	0.165
	Umax	2.668	2.673	2.659	2.660	2.731	2.738	2.722	2.729
	Compliance	0.211	0.223	0.205	0.223	0.205	0.221	0.203	0.215
	Compliance_Cycle	0.217		0.214		0.213		0.209	
	Static Energy	16.209		15.957		16.657		17.137	
	Energy Dissipation	3.216		2.992		3.119		3.080	
Sensor 3	Umin	-0.007	0.389	0.238	0.348	0.250	0.500	0.282	0.269
	Umax	4.693	4.774	4.651	4.775	4.853	4.923	4.742	4.882
	Compliance	0.379	0.397	0.364	0.402	0.365	0.389	0.357	0.386
	Compliance_Cycle	0.388		0.382		0.376		0.371	
	Static Energy	28.993		28.645		29.951		30.657	
	Energy Dissipation	4.850		5.041		5.457		5.140	
Sensor 4	Umin	0.000	0.038	0.027	0.051	0.033	0.054	0.029	0.037
	Umax	0.581	0.582	0.575	0.576	0.590	0.590	0.591	0.591
	Compliance	0.044	0.047	0.043	0.046	0.043	0.047	0.043	0.045
	Compliance_Cycle	0.046		0.045		0.045		0.044	
	Static Energy	3.532		3.454		3.588		3.711	
	Energy Dissipation	0.962		0.803		0.796		0.942	
Sensor 5	Umin	0.001	0.185	0.120	0.204	0.146	0.239	0.140	0.160
	Umax	2.470	2.477	2.452	2.454	2.545	2.565	2.486	2.523
	Compliance	0.192	0.205	0.190	0.204	0.187	0.206	0.184	0.198
	Compliance_Cycle	0.198		0.197		0.196		0.191	
	Static Energy	15.021		14.722		15.605		15.844	
	Energy Dissipation	3.488		2.858		3.196		3.381	
Sensor 6	Umin	-0.005	0.284	0.169	0.316	0.204	0.361	0.196	0.275
	Umax	3.396	3.665	3.383	3.654	3.676	3.776	3.306	3.711
	Compliance	0.263	0.302	0.270	0.299	0.255	0.306	0.245	0.287
	Compliance_Cycle	0.281		0.284		0.278		0.264	
	Static Energy	22.252		21.920		22.972		23.304	
	Energy Dissipation	6.568		5.210		7.062		6.434	
Sensor 7	Umin	0.000	0.032	0.021	0.035	0.025	0.039	0.025	0.027
	Umax	0.446	0.447	0.445	0.445	0.455	0.455	0.457	0.457
	Compliance	0.034	0.037	0.034	0.036	0.034	0.037	0.033	0.036
	Compliance_Cycle	0.035		0.035		0.035		0.035	
	Static Energy	2.712		2.672		2.771		2.869	
	Energy Dissipation	0.621		0.533		0.536		0.598	
Sensor 8	Umin	0.003	0.191	0.120	0.207	0.155	0.237	0.148	0.164
	Umax	2.643	2.649	2.625	2.626	2.695	2.697	2.687	2.691
	Compliance	0.206	0.215	0.203	0.214	0.202	0.216	0.200	0.210
	Compliance_Cycle	0.210		0.208		0.209		0.205	
	Static Energy	16.064		15.753		16.408		16.899	
	Energy Dissipation	3.100		2.627		2.680		3.039	
Sensor 9	Umin	0.000	0.296	0.182	0.293	0.236	0.374	0.217	0.255
	Umax	3.676	3.749	3.652	3.694	3.827	3.832	3.738	3.806
	Compliance	0.287	0.304	0.283	0.303	0.281	0.305	0.278	0.296
	Compliance_Cycle	0.296		0.292		0.293		0.287	
	Static Energy	22.736		22.160		23.313		23.901	
	Energy Dissipation	5.863		4.838		4.982		4.804	
Sensor 10	Umin	0.000	0.127	0.056	-0.071	-0.166	0.121	0.034	0.043
	Umax	2.071	2.081	2.051	2.055	2.238	2.179	2.094	2.108
	Compliance	0.163	0.177	0.161	0.180	0.171	0.181	0.160	0.173
	Compliance_Cycle	0.170		0.170		0.176		0.166	
	Static Energy	12.619		12.756		14.624		13.238	
	Energy Dissipation	3.333		1.927		1.700		3.077	

Config 6 Series 2 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.40	0.51	0.51	0.68	0.68	0.60	0.60	0.68
	Fmax	13.16	13.16	13.09	13.09	10.08	10.08	13.23	13.23
Sensor 1	Umin	0.026	0.033	0.025	0.044	0.036	0.041	0.035	0.035
	Umax	0.353	0.354	0.350	0.351	0.276	0.342	0.359	0.359
	Compliance	0.025	0.027	0.026	0.026	0.024	0.027	0.025	0.028
	Compliance_Cycle	0.026		0.026		0.025		0.026	
	Static Energy	2.241		2.177		1.623		2.255	
	Energy Dissipation	0.579		0.553		0.490		0.664	
Sensor 2	Umin	0.128	0.128	0.104	0.268	0.187	0.238	0.149	0.194
	Umax	2.776	2.777	2.754	2.758	2.134	2.665	2.795	2.796
	Compliance	0.206	0.217	0.204	0.212	0.197	0.212	0.203	0.215
	Compliance_Cycle	0.212		0.208		0.205		0.209	
	Static Energy	17.570		17.111		12.633		17.549	
	Energy Dissipation	3.227		3.358		2.988		3.571	
Sensor 3	Umin	0.200	0.132	0.122	0.540	0.314	0.422	0.228	0.301
	Umax	4.869	4.970	4.792	4.931	3.727	4.736	4.885	5.000
	Compliance	0.365	0.393	0.358	0.375	0.345	0.375	0.355	0.387
	Compliance_Cycle	0.378		0.366		0.359		0.371	
	Static Energy	31.445		30.593		22.450		31.382	
	Energy Dissipation	4.665		6.093		5.862		4.980	
Sensor 4	Umin	0.005	0.032	0.021	0.051	0.035	0.046	0.026	0.023
	Umax	0.600	0.600	0.596	0.596	0.444	0.570	0.604	0.604
	Compliance	0.044	0.046	0.044	0.045	0.041	0.044	0.043	0.046
	Compliance_Cycle	0.045		0.044		0.042		0.045	
	Static Energy	3.797		3.700		2.703		3.793	
	Energy Dissipation	0.998		0.898		0.744		1.144	
Sensor 5	Umin	0.069	0.141	0.116	0.219	0.158	0.210	0.131	0.205
	Umax	2.567	2.577	2.522	2.562	1.975	2.479	2.579	2.601
	Compliance	0.189	0.201	0.186	0.197	0.184	0.197	0.189	0.200
	Compliance_Cycle	0.195		0.192		0.190		0.194	
	Static Energy	16.304		15.895		11.751		16.325	
	Energy Dissipation	3.529		3.373		2.750		3.942	
Sensor 6	Umin	0.097	0.269	0.191	0.322	0.237	0.302	0.187	0.291
	Umax	3.567	3.827	3.376	3.843	2.865	3.749	3.590	3.891
	Compliance	0.259	0.293	0.249	0.290	0.264	0.289	0.270	0.292
	Compliance_Cycle	0.275		0.268		0.276		0.280	
	Static Energy	24.213		23.843		17.772		24.422	
	Energy Dissipation	6.708		6.966		5.076		6.561	
Sensor 7	Umin	0.014	0.023	0.019	0.037	0.027	0.036	0.022	0.032
	Umax	0.465	0.465	0.462	0.462	0.347	0.445	0.470	0.470
	Compliance	0.034	0.036	0.034	0.035	0.032	0.035	0.034	0.036
	Compliance_Cycle	0.035		0.035		0.033		0.035	
	Static Energy	2.943		2.868		2.107		2.948	
	Energy Dissipation	0.627		0.596		0.503		0.718	
Sensor 8	Umin	0.080	0.146	0.124	0.220	0.164	0.210	0.128	0.205
	Umax	2.735	2.738	2.727	2.727	2.073	2.617	2.758	2.758
	Compliance	0.204	0.211	0.202	0.208	0.193	0.207	0.201	0.210
	Compliance_Cycle	0.208		0.205		0.200		0.206	
	Static Energy	17.323		16.919		12.405		17.310	
	Energy Dissipation	3.118		2.839		2.564		3.667	
Sensor 9	Umin	0.116	0.242	0.192	0.356	0.242	0.330	0.189	0.215
	Umax	3.794	3.843	3.782	3.839	2.940	3.711	3.845	3.910
	Compliance	0.283	0.297	0.279	0.292	0.267	0.290	0.280	0.297
	Compliance_Cycle	0.290		0.285		0.278		0.288	
	Static Energy	24.314		23.818		17.591		24.541	
	Energy Dissipation	5.605		5.580		4.717		5.793	
Sensor 10	Umin	-0.024	-0.001	-0.059	0.048	0.019	0.037	-0.004	-0.007
	Umax	2.111	2.111	2.082	2.084	1.624	2.026	2.162	2.162
	Compliance	0.163	0.173	0.161	0.170	0.162	0.169	0.165	0.174
	Compliance_Cycle	0.168		0.165		0.166		0.169	
	Static Energy	13.506		13.298		9.604		13.616	
	Energy Dissipation	2.747		2.483		1.845		3.860	

Config 6 Series 3 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.56	0.56	0.69	0.69	0.67	0.67	0.56
	Fmax	12.49	12.49	13.37	13.37	12.79	12.79	12.84	12.84
Sensor 1	Umin	-0.007	0.023	0.015	0.031	0.020	0.027	0.016	0.023
	Umax	0.326	0.326	0.346	0.354	0.333	0.333	0.329	0.330
	Compliance	0.028	0.029	0.026	0.029	0.026	0.028	0.025	0.029
	Compliance_Cycle	0.029		0.028		0.027		0.027	
	Static Energy	1.983		2.242		2.019		2.026	
	Energy Dissipation	0.496		0.578		0.473		0.501	
Sensor 2	Umin	0.017	0.188	0.117	0.249	0.141	0.198	0.080	0.187
	Umax	2.619	2.620	2.772	2.789	2.663	2.663	2.662	2.664
	Compliance	0.213	0.221	0.204	0.222	0.204	0.217	0.204	0.222
	Compliance_Cycle	0.217		0.213		0.210		0.213	
	Static Energy	15.627		17.681		16.141		16.352	
	Energy Dissipation	3.204		3.404		2.795		3.033	
Sensor 3	Umin	0.006	0.337	0.225	0.499	0.255	0.323	0.105	0.348
	Umax	4.616	4.729	4.843	4.977	4.665	4.718	4.650	4.773
	Compliance	0.375	0.395	0.357	0.395	0.359	0.390	0.365	0.400
	Compliance_Cycle	0.385		0.375		0.374		0.382	
	Static Energy	28.206		31.552		28.596		29.298	
	Energy Dissipation	5.722		6.144		4.438		5.292	
Sensor 4	Umin	0.003	0.044	0.026	0.055	0.035	0.048	0.021	0.044
	Umax	0.564	0.564	0.608	0.611	0.580	0.580	0.582	0.582
	Compliance	0.046	0.046	0.044	0.046	0.043	0.045	0.043	0.046
	Compliance_Cycle	0.046		0.045		0.044		0.044	
	Static Energy	3.366		3.875		3.518		3.571	
	Energy Dissipation	0.854		0.903		0.768		0.814	
Sensor 5	Umin	0.011	0.180	0.102	0.222	0.126	0.192	0.081	0.191
	Umax	2.451	2.457	2.603	2.623	2.482	2.487	2.481	2.487
	Compliance	0.199	0.204	0.191	0.205	0.188	0.199	0.186	0.203
	Compliance_Cycle	0.201		0.198		0.193		0.194	
	Static Energy	14.655		16.629		15.074		15.266	
	Energy Dissipation	3.039		3.254		3.226		3.191	
Sensor 6	Umin	-0.006	0.257	0.131	0.347	0.155	0.300	0.088	0.313
	Umax	3.549	3.635	3.751	3.839	3.531	3.659	3.425	3.738
	Compliance	0.289	0.302	0.277	0.303	0.261	0.293	0.253	0.301
	Compliance_Cycle	0.296		0.289		0.276		0.275	
	Static Energy	21.718		24.338		22.177		22.945	
	Energy Dissipation	5.221		6.070		7.631		6.608	
Sensor 7	Umin	0.003	0.030	0.019	0.037	0.024	0.034	0.016	0.031
	Umax	0.438	0.438	0.471	0.472	0.451	0.451	0.452	0.452
	Compliance	0.036	0.036	0.034	0.037	0.034	0.036	0.034	0.036
	Compliance_Cycle	0.036		0.035		0.035		0.035	
	Static Energy	2.612		2.994		2.734		2.773	
	Energy Dissipation	0.575		0.581		0.520		0.550	
Sensor 8	Umin	0.013	0.172	0.105	0.208	0.133	0.187	0.087	0.175
	Umax	2.596	2.596	2.758	2.771	2.642	2.645	2.657	2.657
	Compliance	0.211	0.215	0.203	0.216	0.202	0.210	0.201	0.215
	Compliance_Cycle	0.213		0.210		0.206		0.208	
	Static Energy	15.484		17.567		16.031		16.309	
	Energy Dissipation	2.855		3.056		2.851		2.787	
Sensor 9	Umin	-0.001	0.253	0.142	0.349	0.198	0.277	0.137	0.297
	Umax	3.620	3.631	3.792	3.869	3.652	3.704	3.672	3.702
	Compliance	0.296	0.302	0.283	0.303	0.278	0.295	0.279	0.301
	Compliance_Cycle	0.299		0.293		0.286		0.289	
	Static Energy	21.665		24.528		22.450		22.724	
	Energy Dissipation	5.256		5.852		5.804		5.030	
Sensor 10	Umin	0.021	0.123	0.080	0.164	0.112	0.113	0.079	0.155
	Umax	2.101	2.101	2.222	2.243	2.144	2.144	2.168	2.168
	Compliance	0.171	0.175	0.164	0.176	0.164	0.172	0.162	0.174
	Compliance_Cycle	0.173		0.170		0.168		0.168	
	Static Energy	12.531		14.220		12.995		13.308	
	Energy Dissipation	2.277		2.378		2.003		2.245	

Config 6 Series 3 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.56	0.70	0.70	0.68	0.68	0.67	0.67	0.56
	Fmax	12.80	12.80	12.97	12.97	12.63	12.63	12.90	12.90
Sensor 1	Umin	0.010	0.026	0.010	0.025	0.015	0.021	0.012	0.018
	Umax	0.327	0.328	0.330	0.330	0.321	0.321	0.328	0.328
	Compliance	0.026	0.029	0.025	0.028	0.025	0.029	0.026	0.027
	Compliance_Cycle	0.027		0.027		0.027		0.027	
	Static Energy	1.984		2.029		1.921		2.024	
	Energy Dissipation	0.491		0.516		0.495		0.502	
Sensor 2	Umin	0.076	0.200	0.073	0.193	0.087	0.194	0.103	0.170
	Umax	2.649	2.651	2.675	2.677	2.612	2.613	2.672	2.674
	Compliance	0.207	0.222	0.204	0.218	0.205	0.220	0.206	0.216
	Compliance_Cycle	0.214		0.211		0.212		0.211	
	Static Energy	16.043		16.447		15.632		16.494	
	Energy Dissipation	3.031		3.031		2.961		3.103	
Sensor 3	Umin	0.153	0.388	0.111	0.346	0.132	0.411	0.166	0.313
	Umax	4.632	4.702	4.651	4.778	4.560	4.682	4.766	4.771
	Compliance	0.366	0.391	0.355	0.392	0.362	0.392	0.364	0.385
	Compliance_Cycle	0.378		0.373		0.377		0.374	
	Static Energy	28.455		29.354		28.010		29.428	
	Energy Dissipation	5.324		5.372		5.151		5.424	
Sensor 4	Umin	0.016	0.052	0.016	0.051	0.028	0.047	0.025	0.044
	Umax	0.577	0.577	0.586	0.587	0.568	0.568	0.584	0.575
	Compliance	0.044	0.047	0.043	0.045	0.043	0.046	0.044	0.045
	Compliance_Cycle	0.045		0.044		0.044		0.045	
	Static Energy	3.493		3.603		3.400		3.602	
	Energy Dissipation	0.810		0.812		0.758		0.789	
Sensor 5	Umin	0.075	0.193	0.074	0.192	0.105	0.194	0.119	0.178
	Umax	2.470	2.472	2.457	2.462	2.426	2.427	2.538	2.528
	Compliance	0.190	0.206	0.187	0.201	0.187	0.203	0.192	0.201
	Compliance_Cycle	0.198		0.194		0.195		0.196	
	Static Energy	14.960		15.126		14.520		15.655	
	Energy Dissipation	3.093		2.953		2.865		3.255	
Sensor 6	Umin	0.074	0.265	0.093	0.245	0.119	0.288	0.160	0.205
	Umax	3.447	3.496	3.197	3.748	3.297	3.443	3.775	3.794
	Compliance	0.266	0.303	0.254	0.294	0.257	0.296	0.277	0.300
	Compliance_Cycle	0.284		0.272		0.275		0.288	
	Static Energy	21.157		23.026		20.598		23.402	
	Energy Dissipation	6.401		5.721		5.416		7.471	
Sensor 7	Umin	0.017	0.037	0.016	0.037	0.022	0.036	0.024	0.035
	Umax	0.450	0.451	0.457	0.457	0.444	0.444	0.456	0.452
	Compliance	0.034	0.037	0.034	0.036	0.034	0.036	0.034	0.036
	Compliance_Cycle	0.036		0.035		0.035		0.035	
	Static Energy	2.726		2.806		2.656		2.811	
	Energy Dissipation	0.529		0.529		0.511		0.529	
Sensor 8	Umin	0.097	0.201	0.095	0.208	0.115	0.190	0.122	0.186
	Umax	2.643	2.644	2.679	2.681	2.618	2.619	2.683	2.655
	Compliance	0.204	0.218	0.203	0.213	0.202	0.216	0.205	0.212
	Compliance_Cycle	0.211		0.208		0.209		0.209	
	Static Energy	16.001		16.471		15.668		16.549	
	Energy Dissipation	2.768		2.771		2.577		2.829	
Sensor 9	Umin	0.114	0.312	0.132	0.309	0.174	0.256	0.190	0.262
	Umax	3.632	3.669	3.663	3.699	3.619	3.625	3.777	3.757
	Compliance	0.283	0.306	0.282	0.298	0.282	0.304	0.286	0.301
	Compliance_Cycle	0.294		0.290		0.292		0.293	
	Static Energy	22.204		22.725		21.687		23.297	
	Energy Dissipation	5.129		5.217		4.678		5.569	
Sensor 10	Umin	0.084	0.171	0.121	0.165	0.127	0.130	0.101	0.114
	Umax	2.138	2.139	2.169	2.174	2.134	2.135	2.174	2.174
	Compliance	0.164	0.176	0.163	0.172	0.161	0.176	0.164	0.173
	Compliance_Cycle	0.170		0.167		0.169		0.168	
	Static Energy	12.945		13.356		12.773		13.410	
	Energy Dissipation	2.148		2.074		2.221		2.297	

Config 7 Series 1 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.64	0.64	0.67	0.67	0.69	0.69	0.64
	Fmax	12.63	12.63	13.25	13.25	13.20	13.20	12.16	12.16
Sensor 1	Umin	0.000	0.020	0.011	0.023	0.011	0.028	0.015	0.026
	Umax	0.374	0.374	0.382	0.383	0.379	0.381	0.352	0.354
	Compliance	0.029	0.032	0.029	0.032	0.029	0.031	0.029	0.031
	Compliance_Cycle	0.031		0.031		0.030		0.030	
	Static Energy	2.241		2.409		2.383		2.037	
	Energy Dissipation	0.288		0.462		0.438		0.366	
Sensor 2	Umin	0.002	0.284	0.203	0.323	0.226	0.369	0.263	0.334
	Umax	3.124	3.128	3.318	3.328	3.318	3.350	3.098	3.151
	Compliance	0.249	0.265	0.240	0.258	0.240	0.257	0.240	0.256
	Compliance_Cycle	0.257		0.248		0.248		0.247	
	Static Energy	18.753		20.931		20.948		18.154	
	Energy Dissipation	4.504		4.400		3.858		3.092	
Sensor 3	Umin	-0.019	0.504	0.381	0.607	0.436	0.734	0.483	0.635
	Umax	5.743	5.946	6.118	6.345	6.195	6.387	5.741	5.985
	Compliance	0.462	0.514	0.436	0.500	0.440	0.502	0.440	0.493
	Compliance_Cycle	0.486		0.466		0.469		0.465	
	Static Energy	35.760		39.906		39.939		34.483	
	Energy Dissipation	11.284		10.840		8.129		6.343	
Sensor 4	Umin	0.002	0.099	0.085	0.119	0.099	0.132	0.109	0.130
	Umax	0.670	0.672	0.726	0.727	0.735	0.737	0.692	0.692
	Compliance	0.053	0.051	0.049	0.050	0.048	0.050	0.048	0.049
	Compliance_Cycle	0.052		0.049		0.049		0.048	
	Static Energy	4.029		4.569		4.609		3.985	
	Energy Dissipation	1.257		1.072		1.002		0.803	
Sensor 5	Umin	0.002	0.381	0.334	0.447	0.365	0.494	0.382	0.466
	Umax	3.135	3.145	3.354	3.363	3.351	3.372	3.131	3.155
	Compliance	0.249	0.249	0.230	0.243	0.229	0.243	0.230	0.239
	Compliance_Cycle	0.249		0.236		0.236		0.235	
	Static Energy	18.855		21.151		21.085		18.178	
	Energy Dissipation	5.297		4.168		3.757		3.052	
Sensor 6	Umin	0.001	0.502	0.503	0.646	0.527	0.725	0.547	0.666
	Umax	4.702	4.905	5.078	5.158	5.122	5.192	4.786	4.858
	Compliance	0.378	0.388	0.343	0.379	0.344	0.377	0.351	0.372
	Compliance_Cycle	0.383		0.360		0.360		0.361	
	Static Energy	29.407		32.440		32.466		27.989	
	Energy Dissipation	9.438		7.753		6.714		5.341	
Sensor 7	Umin	0.001	0.070	0.061	0.079	0.066	0.084	0.069	0.082
	Umax	0.527	0.528	0.561	0.562	0.562	0.564	0.527	0.527
	Compliance	0.042	0.041	0.038	0.040	0.038	0.040	0.038	0.040
	Compliance_Cycle	0.042		0.039		0.039		0.039	
	Static Energy	3.163		3.532		3.527		3.037	
	Energy Dissipation	0.941		0.677		0.657		0.547	
Sensor 8	Umin	0.008	0.404	0.336	0.452	0.363	0.483	0.381	0.470
	Umax	3.295	3.307	3.513	3.519	3.489	3.506	3.278	3.291
	Compliance	0.263	0.259	0.245	0.254	0.244	0.253	0.244	0.252
	Compliance_Cycle	0.261		0.250		0.248		0.248	
	Static Energy	19.826		22.132		21.923		18.961	
	Energy Dissipation	4.715		3.645		3.319		2.974	
Sensor 9	Umin	0.008	0.702	0.579	0.733	0.608	0.595	0.421	0.559
	Umax	4.819	4.887	5.118	5.134	5.051	5.090	4.641	4.703
	Compliance	0.394	0.385	0.356	0.369	0.354	0.385	0.359	0.372
	Compliance_Cycle	0.389		0.362		0.369		0.365	
	Static Energy	29.299		32.290		31.828		27.096	
	Energy Dissipation	8.625		6.327		4.541		5.325	
Sensor 10	Umin	0.005	0.275	0.240	0.305	0.239	0.328	0.264	0.319
	Umax	2.535	2.545	2.710	2.710	2.682	2.722	2.497	2.502
	Compliance	0.202	0.201	0.188	0.199	0.188	0.199	0.188	0.196
	Compliance_Cycle	0.202		0.193		0.193		0.192	
	Static Energy	15.258		17.044		17.021		14.415	
	Energy Dissipation	3.624		3.198		2.697		2.295	

Config 7 Series 1 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.64	0.63	0.63	0.64	0.64	0.62	0.62	0.69
	Fmax	13.01	13.01	12.94	12.94	13.13	13.13	12.75	12.75
Sensor 1	Umin	0.014	0.027	0.011	0.019	0.013	0.032	0.024	0.035
	Umax	0.377	0.377	0.373	0.374	0.388	0.388	0.374	0.374
	Compliance	0.029	0.031	0.029	0.032	0.030	0.030	0.029	0.031
	Compliance_Cycle	0.030		0.030		0.030		0.030	
	Static Energy	2.333		2.298		2.430		2.259	
	Energy Dissipation	0.460		0.409		0.419		0.370	
Sensor 2	Umin	0.250	0.357	0.227	0.310	0.224	0.351	0.244	0.367
	Umax	3.320	3.324	3.277	3.277	3.323	3.375	3.212	3.217
	Compliance	0.244	0.258	0.241	0.261	0.244	0.252	0.241	0.258
	Compliance_Cycle	0.251		0.251		0.248		0.249	
	Static Energy	20.584		20.149		21.116		19.406	
	Energy Dissipation	3.519		3.425		3.643		3.339	
Sensor 3	Umin	0.446	0.767	0.401	0.535	0.423	0.731	0.448	0.708
	Umax	6.237	6.317	6.094	6.269	6.202	6.574	5.951	6.091
	Compliance	0.460	0.493	0.449	0.507	0.460	0.485	0.448	0.501
	Compliance_Cycle	0.476		0.476		0.472		0.473	
	Static Energy	39.117		38.546		41.131		36.743	
	Energy Dissipation	7.238		6.993		7.651		7.308	
Sensor 4	Umin	0.112	0.135	0.111	0.127	0.115	0.140	0.121	0.148
	Umax	0.733	0.733	0.733	0.733	0.743	0.747	0.727	0.727
	Compliance	0.048	0.050	0.048	0.051	0.048	0.049	0.047	0.050
	Compliance_Cycle	0.049		0.050		0.048		0.049	
	Static Energy	4.537		4.507		4.676		4.383	
	Energy Dissipation	0.970		0.919		0.978		0.862	
Sensor 5	Umin	0.380	0.483	0.374	0.445	0.385	0.487	0.403	0.520
	Umax	3.356	3.353	3.295	3.295	3.354	3.386	3.254	3.261
	Compliance	0.231	0.244	0.228	0.246	0.231	0.237	0.228	0.242
	Compliance_Cycle	0.237		0.237		0.234		0.235	
	Static Energy	20.782		20.260		21.185		19.672	
	Energy Dissipation	3.498		3.421		3.658		3.359	
Sensor 6	Umin	0.535	0.718	0.547	0.600	0.520	0.712	0.582	0.715
	Umax	5.228	5.235	4.995	5.086	5.129	5.261	4.916	4.992
	Compliance	0.356	0.379	0.345	0.384	0.353	0.370	0.341	0.377
	Compliance_Cycle	0.367		0.364		0.362		0.358	
	Static Energy	32.417		31.272		32.916		30.114	
	Energy Dissipation	5.923		6.241		6.609		6.285	
Sensor 7	Umin	0.070	0.084	0.069	0.083	0.070	0.085	0.074	0.091
	Umax	0.560	0.560	0.555	0.555	0.563	0.566	0.548	0.548
	Compliance	0.038	0.040	0.038	0.040	0.038	0.039	0.038	0.040
	Compliance_Cycle	0.039		0.039		0.039		0.039	
	Static Energy	3.466		3.411		3.542		3.307	
	Energy Dissipation	0.621		0.596		0.629		0.563	
Sensor 8	Umin	0.384	0.479	0.385	0.454	0.386	0.488	0.405	0.515
	Umax	3.481	3.484	3.449	3.450	3.503	3.531	3.423	3.424
	Compliance	0.244	0.256	0.243	0.257	0.244	0.249	0.243	0.254
	Compliance_Cycle	0.250		0.250		0.246		0.249	
	Static Energy	21.574		21.213		22.092		20.655	
	Energy Dissipation	3.380		3.208		3.527		3.162	
Sensor 9	Umin	0.409	0.562	0.411	0.504	0.410	0.582	0.429	0.616
	Umax	4.933	4.955	4.829	4.876	4.924	4.996	4.850	4.869
	Compliance	0.362	0.379	0.356	0.379	0.358	0.362	0.358	0.376
	Compliance_Cycle	0.370		0.367		0.360		0.367	
	Static Energy	30.683		29.981		31.258		29.372	
	Energy Dissipation	5.681		5.724		6.573		5.969	
Sensor 10	Umin	0.262	0.330	0.243	0.263	0.237	0.308	0.259	0.328
	Umax	2.678	2.678	2.633	2.635	2.681	2.694	2.610	2.610
	Compliance	0.190	0.200	0.188	0.202	0.191	0.196	0.189	0.199
	Compliance_Cycle	0.195		0.195		0.193		0.194	
	Static Energy	16.583		16.202		16.855		15.745	
	Energy Dissipation	2.999		2.785		2.817		2.392	

Config 7 Series 2 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.67	0.67	0.62	0.62	0.62	0.62	0.69
	Fmax	12.86	12.86	12.80	12.80	12.95	12.95	12.92	12.92
Sensor 1	Umin	-0.003	0.046	0.033	0.035	0.024	0.050	0.037	0.052
	Umax	0.380	0.380	0.378	0.380	0.381	0.381	0.383	0.383
	Compliance	0.031	0.032	0.028	0.030	0.029	0.029	0.028	0.030
	Compliance_Cycle	0.032		0.029		0.029		0.029	
	Static Energy	2.331		2.317		2.347		2.342	
	Energy Dissipation	0.451		0.359		0.406		0.400	
Sensor 2	Umin	0.002	0.193	0.116	0.239	0.120	0.236	0.101	0.244
	Umax	3.097	3.097	3.116	3.131	3.141	3.141	3.129	3.130
	Compliance	0.249	0.258	0.243	0.248	0.241	0.249	0.240	0.258
	Compliance_Cycle	0.253		0.245		0.244		0.249	
	Static Energy	18.877		19.075		19.366		19.144	
	Energy Dissipation	3.651		3.332		3.504		3.366	
Sensor 3	Umin	-0.095	0.233	0.116	0.401	0.104	0.398	0.063	0.363
	Umax	5.636	5.670	5.736	5.977	5.777	6.006	5.719	5.845
	Compliance	0.465	0.500	0.459	0.482	0.451	0.484	0.451	0.502
	Compliance_Cycle	0.482		0.470		0.467		0.475	
	Static Energy	35.140		36.415		37.031		35.749	
	Energy Dissipation	7.284		6.807		7.788		7.108	
Sensor 4	Umin	0.007	0.048	0.025	0.056	0.031	0.061	0.033	0.067
	Umax	0.634	0.634	0.635	0.635	0.643	0.642	0.648	0.648
	Compliance	0.051	0.051	0.048	0.048	0.047	0.048	0.048	0.050
	Compliance_Cycle	0.051		0.048		0.048		0.049	
	Static Energy	3.867		3.869		3.962		3.961	
	Energy Dissipation	1.016		0.905		0.906		0.906	
Sensor 5	Umin	0.033	0.181	0.110	0.236	0.114	0.253	0.113	0.254
	Umax	2.934	2.935	3.022	3.033	2.999	3.000	2.993	2.993
	Compliance	0.235	0.242	0.231	0.233	0.227	0.232	0.226	0.241
	Compliance_Cycle	0.238		0.232		0.229		0.233	
	Static Energy	17.890		18.478		18.497		18.306	
	Energy Dissipation	3.744		3.464		3.538		3.437	
Sensor 6	Umin	0.035	0.200	0.150	0.371	0.128	0.382	0.149	0.319
	Umax	4.235	4.358	4.709	4.754	4.448	4.657	4.402	4.477
	Compliance	0.346	0.373	0.353	0.362	0.335	0.356	0.336	0.371
	Compliance_Cycle	0.359		0.358		0.345		0.353	
	Static Energy	26.564		28.964		28.713		27.382	
	Energy Dissipation	6.556		6.685		6.873		6.330	
Sensor 7	Umin	0.006	0.033	0.017	0.037	0.020	0.038	0.018	0.042
	Umax	0.495	0.495	0.496	0.496	0.501	0.501	0.503	0.503
	Compliance	0.040	0.040	0.038	0.038	0.038	0.038	0.038	0.040
	Compliance_Cycle	0.040		0.038		0.038		0.039	
	Static Energy	3.018		3.024		3.091		3.075	
	Energy Dissipation	0.633		0.593		0.585		0.575	
Sensor 8	Umin	0.038	0.213	0.111	0.235	0.129	0.241	0.123	0.259
	Umax	3.140	3.143	3.159	3.162	3.195	3.194	3.182	3.182
	Compliance	0.252	0.254	0.244	0.245	0.242	0.245	0.242	0.255
	Compliance_Cycle	0.253		0.245		0.244		0.248	
	Static Energy	19.158		19.264		19.699		19.462	
	Energy Dissipation	3.667		3.237		3.297		3.262	
Sensor 9	Umin	0.035	0.300	0.172	0.353	0.179	0.367	0.164	0.371
	Umax	4.501	4.543	4.591	4.607	4.621	4.629	4.549	4.573
	Compliance	0.370	0.371	0.356	0.354	0.353	0.354	0.352	0.375
	Compliance_Cycle	0.370		0.355		0.353		0.363	
	Static Energy	27.691		28.068		28.541		27.969	
	Energy Dissipation	6.620		6.039		6.215		6.143	
Sensor 10	Umin	0.026	0.147	0.081	0.154	0.098	0.159	0.083	0.148
	Umax	2.454	2.454	2.435	2.443	2.468	2.468	2.469	2.469
	Compliance	0.195	0.199	0.190	0.192	0.188	0.192	0.188	0.200
	Compliance_Cycle	0.197		0.191		0.190		0.194	
	Static Energy	14.958		14.884		15.217		15.101	
	Energy Dissipation	2.734		2.556		2.557		2.607	

Config 7 Series 2 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.69	0.64	0.64	0.66	0.66	0.65	0.65	0.58
	Fmax	12.49	12.49	12.76	12.76	12.90	12.90	12.44	12.44
Sensor 1	Umin	0.040	0.039	0.035	0.049	0.041	0.043	0.028	0.050
	Umax	0.367	0.368	0.376	0.377	0.379	0.379	0.369	0.369
	Compliance	0.027	0.030	0.028	0.031	0.028	0.029	0.029	0.028
	Compliance_Cycle	0.028		0.030		0.029		0.029	
	Static Energy	2.182		2.278		2.322		2.187	
	Energy Dissipation	0.327		0.421		0.383		0.372	
Sensor 2	Umin	0.116	0.224	0.148	0.242	0.122	0.257	0.108	0.246
	Umax	3.031	3.040	3.106	3.106	3.141	3.141	3.030	3.030
	Compliance	0.240	0.252	0.241	0.260	0.244	0.252	0.243	0.254
	Compliance_Cycle	0.246		0.250		0.248		0.248	
	Static Energy	18.013		18.789		19.241		17.972	
	Energy Dissipation	3.141		3.244		3.531		3.199	
Sensor 3	Umin	0.098	0.322	0.169	0.336	0.117	0.492	0.114	0.448
	Umax	5.558	5.792	5.694	5.747	5.951	5.948	5.639	5.639
	Compliance	0.450	0.491	0.455	0.506	0.458	0.488	0.454	0.492
	Compliance_Cycle	0.470		0.479		0.472		0.472	
	Static Energy	34.320		34.766		36.455		33.446	
	Energy Dissipation	6.933		6.309		8.287		7.170	
Sensor 4	Umin	0.041	0.064	0.049	0.066	0.044	0.075	0.044	0.075
	Umax	0.629	0.629	0.645	0.645	0.654	0.643	0.634	0.627
	Compliance	0.047	0.048	0.047	0.051	0.049	0.049	0.048	0.049
	Compliance_Cycle	0.048		0.049		0.049		0.049	
	Static Energy	3.729		3.901		4.007		3.758	
	Energy Dissipation	0.804		0.883		0.874		0.799	
Sensor 5	Umin	0.133	0.252	0.166	0.230	0.143	0.267	0.138	0.270
	Umax	2.894	2.911	2.985	2.986	3.027	3.020	2.902	2.902
	Compliance	0.226	0.235	0.225	0.244	0.231	0.239	0.229	0.237
	Compliance_Cycle	0.230		0.234		0.235		0.233	
	Static Energy	17.249		18.063		18.543		17.212	
	Energy Dissipation	3.156		3.324		3.460		3.177	
Sensor 6	Umin	0.156	0.299	0.242	0.275	0.163	0.411	0.190	0.430
	Umax	4.263	4.486	4.429	4.596	4.693	4.683	4.372	4.377
	Compliance	0.333	0.364	0.331	0.381	0.345	0.372	0.345	0.363
	Compliance_Cycle	0.348		0.354		0.358		0.354	
	Static Energy	26.582		27.803		28.748		25.961	
	Energy Dissipation	5.964		5.778		6.621		6.092	
Sensor 7	Umin	0.022	0.040	0.027	0.039	0.023	0.042	0.023	0.040
	Umax	0.487	0.487	0.498	0.498	0.502	0.497	0.487	0.486
	Compliance	0.038	0.039	0.038	0.040	0.039	0.040	0.038	0.040
	Compliance_Cycle	0.038		0.039		0.039		0.039	
	Static Energy	2.887		3.013		3.077		2.889	
	Energy Dissipation	0.541		0.566		0.575		0.532	
Sensor 8	Umin	0.146	0.248	0.169	0.244	0.144	0.263	0.148	0.250
	Umax	3.079	3.084	3.153	3.153	3.194	3.156	3.095	3.079
	Compliance	0.241	0.248	0.242	0.256	0.247	0.252	0.245	0.254
	Compliance_Cycle	0.245		0.249		0.249		0.249	
	Static Energy	18.274		19.074		19.566		18.357	
	Energy Dissipation	2.945		3.198		3.206		3.006	
Sensor 9	Umin	0.193	0.361	0.228	0.355	0.203	0.391	0.201	0.380
	Umax	4.420	4.492	4.526	4.551	4.598	4.593	4.493	4.489
	Compliance	0.351	0.362	0.351	0.376	0.358	0.372	0.358	0.379
	Compliance_Cycle	0.356		0.363		0.365		0.368	
	Static Energy	26.617		27.531		28.166		26.649	
	Energy Dissipation	5.572		5.421		6.225		5.862	
Sensor 10	Umin	0.093	0.165	0.113	0.164	0.104	0.193	0.113	0.169
	Umax	2.380	2.392	2.453	2.453	2.470	2.456	2.391	2.389
	Compliance	0.188	0.194	0.188	0.200	0.192	0.197	0.190	0.198
	Compliance_Cycle	0.191		0.194		0.194		0.194	
	Static Energy	14.174		14.839		15.131		14.181	
	Energy Dissipation	2.278		2.693		2.506		2.312	

Config 7 Series 3 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.68	0.68	0.65	0.65	0.69	0.69	0.69
	Fmax	13.18	13.18	13.38	13.38	11.84	11.84	11.28	11.28
Sensor 1	Umin	-0.003	0.044	0.035	0.040	0.033	0.037	0.035	0.041
	Umax	0.378	0.380	0.383	0.386	0.351	0.376	0.323	0.396
	Compliance	0.030	0.030	0.027	0.030	0.027	0.029	0.027	0.029
	Compliance_Cycle	0.030		0.029		0.028		0.028	
	Static Energy	2.389		2.454		2.097		2.094	
	Energy Dissipation	0.449		0.485		0.412		0.459	
Sensor 2	Umin	-0.005	0.223	0.137	0.185	0.125	0.177	0.135	0.211
	Umax	3.193	3.210	3.234	3.259	2.891	3.189	2.705	3.328
	Compliance	0.245	0.258	0.240	0.264	0.242	0.253	0.244	0.254
	Compliance_Cycle	0.251		0.251		0.247		0.249	
	Static Energy	20.084		20.739		17.773		17.617	
	Energy Dissipation	3.720		3.730		3.535		3.471	
Sensor 3	Umin	-0.041	0.293	0.084	0.143	0.046	0.134	0.048	0.254
	Umax	5.806	6.025	5.846	6.028	5.271	6.020	4.866	6.199
	Compliance	0.456	0.501	0.444	0.513	0.454	0.492	0.468	0.489
	Compliance_Cycle	0.477		0.476		0.472		0.478	
	Static Energy	37.897		38.360		33.550		32.815	
	Energy Dissipation	7.553		8.102		7.890		6.855	
Sensor 4	Umin	-0.001	0.053	0.034	0.049	0.034	0.048	0.040	0.056
	Umax	0.650	0.650	0.660	0.666	0.573	0.633	0.542	0.674
	Compliance	0.048	0.050	0.047	0.052	0.046	0.048	0.046	0.049
	Compliance_Cycle	0.049		0.049		0.047		0.047	
	Static Energy	4.067		4.239		3.527		3.569	
	Energy Dissipation	0.985		0.962		0.855		0.955	
Sensor 5	Umin	-0.021	0.215	0.133	0.181	0.123	0.169	0.137	0.220
	Umax	3.049	3.080	3.039	3.084	2.740	3.045	2.582	3.184
	Compliance	0.232	0.242	0.226	0.247	0.226	0.236	0.227	0.238
	Compliance_Cycle	0.237		0.236		0.231		0.232	
	Static Energy	19.374		19.625		16.970		16.855	
	Energy Dissipation	3.775		3.680		3.396		3.663	
Sensor 6	Umin	-0.085	0.287	0.137	0.162	0.136	0.116	0.165	0.294
	Umax	4.601	4.707	4.315	4.573	4.093	4.675	3.825	4.843
	Compliance	0.352	0.375	0.331	0.382	0.334	0.366	0.345	0.366
	Compliance_Cycle	0.363		0.355		0.349		0.355	
	Static Energy	29.937		29.101		26.054		25.637	
	Energy Dissipation	7.289		6.766		6.360		6.523	
Sensor 7	Umin	0.000	0.034	0.023	0.031	0.021	0.032	0.024	0.034
	Umax	0.506	0.508	0.514	0.517	0.459	0.503	0.432	0.525
	Compliance	0.038	0.040	0.038	0.041	0.038	0.039	0.037	0.039
	Compliance_Cycle	0.039		0.039		0.038		0.038	
	Static Energy	3.174		3.291		2.801		2.778	
	Energy Dissipation	0.620		0.613		0.596		0.616	
Sensor 8	Umin	-0.018	0.218	0.143	0.196	0.128	0.206	0.150	0.215
	Umax	3.223	3.236	3.261	3.294	2.933	3.195	2.760	3.346
	Compliance	0.245	0.254	0.242	0.259	0.243	0.249	0.241	0.251
	Compliance_Cycle	0.249		0.250		0.246		0.246	
	Static Energy	20.327		20.962		17.806		17.712	
	Energy Dissipation	3.566		3.463		3.097		3.349	
Sensor 9	Umin	-0.045	0.335	0.191	0.300	0.191	0.287	0.209	0.330
	Umax	4.695	4.737	4.690	4.767	4.349	4.666	4.094	4.829
	Compliance	0.363	0.374	0.355	0.384	0.355	0.365	0.356	0.366
	Compliance_Cycle	0.369		0.369		0.360		0.361	
	Static Energy	29.876		30.335		26.004		25.563	
	Energy Dissipation	6.791		6.294		5.922		6.044	
Sensor 10	Umin	-0.009	0.169	0.111	0.145	0.094	0.163	0.110	0.151
	Umax	2.520	2.526	2.544	2.556	2.260	2.496	2.119	2.583
	Compliance	0.191	0.198	0.187	0.203	0.187	0.195	0.187	0.196
	Compliance_Cycle	0.195		0.195		0.191		0.192	
	Static Energy	15.837		16.265		13.911		13.673	
	Energy Dissipation	2.684		2.846		2.768		3.032	

Config 7 Series 3 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.69	0.68	0.68	0.69	0.69	0.69	0.69	0.60
	Fmax	12.61	12.61	12.66	12.66	12.67	12.67	12.45	12.45
Sensor 1	Umin	0.038	0.030	0.026	0.041	0.039	0.044	0.036	0.042
	Umax	0.368	0.374	0.375	0.375	0.366	0.367	0.362	0.362
	Compliance	0.028	0.031	0.029	0.030	0.027	0.029	0.027	0.030
	Compliance_Cycle	0.029		0.029		0.028		0.029	
	Static Energy	2.234		2.246		2.195		2.147	
	Energy Dissipation	0.318		0.415		0.370		0.373	
Sensor 2	Umin	0.153	0.192	0.153	0.184	0.146	0.187	0.125	0.203
	Umax	3.038	3.102	3.065	3.069	3.067	3.067	3.009	3.009
	Compliance	0.243	0.259	0.244	0.260	0.243	0.263	0.243	0.259
	Compliance_Cycle	0.251		0.252		0.253		0.251	
	Static Energy	18.509		18.364		18.365		17.827	
	Energy Dissipation	2.947		3.126		3.095		3.076	
Sensor 3	Umin	0.097	0.144	0.078	0.162	0.079	0.157	0.050	0.192
	Umax	5.447	5.757	5.532	5.683	5.532	5.674	5.430	5.622
	Compliance	0.462	0.504	0.463	0.503	0.459	0.512	0.461	0.505
	Compliance_Cycle	0.482		0.482		0.484		0.482	
	Static Energy	34.351		34.006		33.976		33.309	
	Energy Dissipation	5.954		6.714		6.534		6.451	
Sensor 4	Umin	0.047	0.054	0.047	0.049	0.043	0.051	0.039	0.056
	Umax	0.627	0.632	0.629	0.629	0.629	0.630	0.617	0.618
	Compliance	0.047	0.050	0.047	0.050	0.047	0.051	0.047	0.050
	Compliance_Cycle	0.049		0.049		0.049		0.048	
	Static Energy	3.769		3.764		3.769		3.660	
	Energy Dissipation	0.779		0.781		0.806		0.795	
Sensor 5	Umin	0.157	0.203	0.162	0.175	0.144	0.204	0.144	0.224
	Umax	2.889	2.956	2.916	2.921	2.938	2.938	2.857	2.857
	Compliance	0.228	0.243	0.228	0.243	0.228	0.247	0.226	0.242
	Compliance_Cycle	0.235		0.235		0.237		0.234	
	Static Energy	17.638		17.479		17.593		16.927	
	Energy Dissipation	3.071		2.988		3.110		3.149	
Sensor 6	Umin	0.191	0.237	0.183	0.141	0.133	0.191	0.145	0.201
	Umax	4.197	4.439	4.263	4.381	4.362	4.379	4.136	4.319
	Compliance	0.340	0.377	0.343	0.377	0.345	0.386	0.334	0.375
	Compliance_Cycle	0.358		0.359		0.365		0.353	
	Static Energy	26.487		26.215		26.221		25.589	
	Energy Dissipation	5.450		5.053		5.644		5.602	
Sensor 7	Umin	0.027	0.036	0.030	0.033	0.028	0.035	0.027	0.037
	Umax	0.490	0.493	0.491	0.491	0.492	0.492	0.483	0.483
	Compliance	0.038	0.040	0.038	0.040	0.038	0.041	0.038	0.040
	Compliance_Cycle	0.039		0.039		0.039		0.039	
	Static Energy	2.940		2.940		2.948		2.863	
	Energy Dissipation	0.539		0.528		0.539		0.539	
Sensor 8	Umin	0.168	0.213	0.186	0.203	0.165	0.213	0.155	0.216
	Umax	3.105	3.143	3.127	3.131	3.134	3.134	3.070	3.075
	Compliance	0.244	0.257	0.243	0.256	0.242	0.260	0.242	0.255
	Compliance_Cycle	0.250		0.250		0.251		0.248	
	Static Energy	18.754		18.735		18.766		18.218	
	Energy Dissipation	2.929		2.951		2.915		2.868	
Sensor 9	Umin	0.245	0.306	0.257	0.286	0.218	0.295	0.206	0.307
	Umax	4.513	4.598	4.547	4.570	4.551	4.561	4.451	4.480
	Compliance	0.356	0.380	0.358	0.379	0.355	0.387	0.354	0.377
	Compliance_Cycle	0.368		0.368		0.370		0.365	
	Static Energy	27.436		27.346		27.311		26.543	
	Energy Dissipation	5.260		5.246		5.444		4.991	
Sensor 10	Umin	0.129	0.180	0.142	0.126	0.114	0.125	0.103	0.153
	Umax	2.413	2.423	2.413	2.415	2.413	2.415	2.375	2.376
	Compliance	0.189	0.198	0.187	0.199	0.187	0.202	0.188	0.201
	Compliance_Cycle	0.194		0.193		0.194		0.194	
	Static Energy	14.458		14.451		14.461		14.077	
	Energy Dissipation	2.252		2.328		2.488		2.908	

Config 8 Series 1 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.69	0.69	0.66	0.66	0.60	0.60	0.65
	Fmax	10.90	10.90	12.58	12.58	12.92	12.92	12.51	12.51
Sensor 1	Umin	0.000	0.102	0.078	0.101	0.082	0.111	0.088	0.114
	Umax	0.426	0.497	0.490	0.492	0.501	0.502	0.490	0.490
	Compliance	0.040	0.033	0.034	0.034	0.034	0.033	0.034	0.033
	Compliance_Cycle	0.036		0.034		0.033		0.033	
	Static Energy	2.534		2.930		3.092		2.908	
	Energy Dissipation	0.808		0.466		0.457		0.446	
Sensor 2	Umin	-0.013	1.375	1.107	1.398	1.174	1.407	1.223	1.456
	Umax	4.338	5.209	5.217	5.226	5.365	5.373	5.260	5.269
	Compliance	0.396	0.323	0.327	0.342	0.328	0.340	0.327	0.335
	Compliance_Cycle	0.356		0.335		0.334		0.331	
	Static Energy	26.646		31.135		33.096		31.244	
	Energy Dissipation	13.741		6.136		6.116		5.655	
Sensor 3	Umin	-0.047	3.001	2.468	2.995	2.571	3.085	2.664	3.171
	Umax	9.091	10.990	10.920	11.000	11.200	11.300	11.020	11.330
	Compliance	0.828	0.680	0.673	0.731	0.677	0.723	0.676	0.713
	Compliance_Cycle	0.747		0.700		0.700		0.694	
	Static Energy	56.322		65.536		69.605		67.184	
	Energy Dissipation	32.835		14.794		14.693		14.115	
Sensor 4	Umin	-0.001	0.167	0.134	0.191	0.161	0.215	0.187	0.238
	Umax	0.602	0.728	0.757	0.758	0.804	0.805	0.804	0.804
	Compliance	0.054	0.046	0.049	0.048	0.050	0.048	0.049	0.048
	Compliance_Cycle	0.050		0.049		0.049		0.049	
	Static Energy	3.719		4.518		4.956		4.766	
	Energy Dissipation	1.675		0.885		0.883		0.773	
Sensor 5	Umin	-0.014	1.353	1.098	1.366	1.169	1.422	1.212	1.451
	Umax	4.099	5.042	5.033	5.036	5.134	5.139	5.020	5.065
	Compliance	0.373	0.306	0.309	0.325	0.306	0.322	0.304	0.317
	Compliance_Cycle	0.336		0.317		0.314		0.310	
	Static Energy	25.798		30.003		31.655		30.034	
	Energy Dissipation	14.150		6.199		6.594		5.909	
Sensor 6	Umin	-0.043	2.445	1.934	2.413	2.053	2.599	2.080	2.557
	Umax	7.033	9.001	8.858	9.025	8.800	9.294	8.586	9.062
	Compliance	0.631	0.541	0.535	0.582	0.513	0.571	0.509	0.558
	Compliance_Cycle	0.583		0.558		0.540		0.532	
	Static Energy	46.150		53.769		57.249		53.735	
	Energy Dissipation	29.458		13.768		15.552		14.394	
Sensor 7	Umin	-0.001	0.169	0.139	0.175	0.147	0.176	0.153	0.182
	Umax	0.592	0.706	0.711	0.711	0.734	0.734	0.718	0.718
	Compliance	0.055	0.044	0.046	0.047	0.046	0.046	0.046	0.046
	Compliance_Cycle	0.049		0.046		0.046		0.046	
	Static Energy	3.607		4.238		4.521		4.257	
	Energy Dissipation	1.666		0.755		0.763		0.683	
Sensor 8	Umin	-0.015	1.454	1.206	1.487	1.272	1.500	1.315	1.540
	Umax	4.287	4.804	4.800	4.804	4.800	4.804	4.802	4.802
	Compliance	0.402	0.289	0.306	0.304	0.303	0.293	0.301	0.288
	Compliance_Cycle	0.336		0.305		0.298		0.295	
	Static Energy	24.591		28.621		29.591		28.474	
	Energy Dissipation	13.220		5.356		5.159		4.672	
Sensor 9	Umin	-0.019	1.166	0.661	0.520	0.172	0.660	0.323	0.536
	Umax	4.972	4.978	4.976	4.976	4.968	4.986	4.953	4.986
	Compliance	0.528	0.359	0.402	0.418	0.444	0.388	0.429	0.402
	Compliance_Cycle	0.427		0.410		0.415		0.415	
	Static Energy	25.498		29.646		30.713		29.565	
	Energy Dissipation	8.212		4.069		10.365		6.883	
Sensor 10	Umin	0.001	0.900	0.757	0.915	0.796	0.930	0.844	0.986
	Umax	3.253	3.919	3.913	3.925	4.023	4.024	3.941	3.946
	Compliance	0.295	0.247	0.252	0.259	0.252	0.259	0.251	0.255
	Compliance_Cycle	0.269		0.255		0.255		0.253	
	Static Energy	19.998		23.384		24.787		23.399	
	Energy Dissipation	9.394		3.952		4.119		3.679	

Config 8 Series 1 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.65	0.69	0.69	0.68	0.68	0.54	0.54	0.65
	Fmax	13.90	13.90	12.61	12.61	13.00	13.00	12.68	12.68
Sensor 1	Umin	0.092	0.122	0.094	0.117	0.094	0.120	0.105	0.144
	Umax	0.538	0.539	0.496	0.496	0.511	0.513	0.504	0.504
	Compliance	0.033	0.032	0.033	0.033	0.033	0.033	0.034	0.030
	Compliance_Cycle	0.033		0.033		0.033		0.032	
	Static Energy	3.561		2.957		3.193		3.032	
	Energy Dissipation	0.534		0.437		0.472		0.506	
Sensor 2	Umin	1.249	1.602	1.322	1.587	1.334	1.554	1.461	1.580
	Umax	5.821	5.871	5.397	5.421	5.533	5.577	5.472	5.472
	Compliance	0.329	0.336	0.324	0.338	0.324	0.338	0.338	0.347
	Compliance_Cycle	0.332		0.331		0.331		0.342	
	Static Energy	38.768		32.340		34.743		32.917	
	Energy Dissipation	7.831		5.716		5.851		5.418	
Sensor 3	Umin	2.770	3.538	2.875	3.491	2.927	3.410	3.176	3.426
	Umax	12.120	12.630	11.320	11.680	11.550	12.030	11.770	11.740
	Compliance	0.681	0.717	0.669	0.725	0.670	0.724	0.711	0.747
	Compliance_Cycle	0.698		0.696		0.696		0.728	
	Static Energy	83.399		69.679		74.943		70.802	
	Energy Dissipation	19.483		14.320		14.569		13.088	
Sensor 4	Umin	0.210	0.290	0.252	0.305	0.267	0.320	0.306	0.340
	Umax	0.915	0.916	0.874	0.874	0.915	0.917	0.916	0.903
	Compliance	0.050	0.048	0.049	0.048	0.049	0.048	0.051	0.049
	Compliance_Cycle	0.049		0.049		0.049		0.050	
	Static Energy	6.048		5.211		5.709		5.512	
	Energy Dissipation	1.227		0.779		0.856		0.767	
Sensor 5	Umin	1.239	1.585	1.334	1.603	1.333	1.569	1.473	1.595
	Umax	5.557	5.714	5.147	5.229	5.296	5.405	5.353	5.329
	Compliance	0.308	0.318	0.298	0.318	0.299	0.321	0.323	0.328
	Compliance_Cycle	0.313		0.308		0.309		0.326	
	Static Energy	37.731		31.195		33.671		32.201	
	Energy Dissipation	8.348		6.066		6.396		5.555	
Sensor 6	Umin	2.135	2.795	2.302	2.871	2.267	2.759	2.510	2.746
	Umax	9.287	10.270	8.578	9.291	8.855	9.599	9.509	9.462
	Compliance	0.513	0.560	0.474	0.559	0.479	0.568	0.566	0.591
	Compliance_Cycle	0.535		0.513		0.519		0.578	
	Static Energy	67.815		55.427		59.798		57.201	
	Energy Dissipation	19.708		14.921		16.229		13.054	
Sensor 7	Umin	0.157	0.201	0.170	0.202	0.171	0.196	0.186	0.203
	Umax	0.798	0.798	0.739	0.739	0.760	0.761	0.745	0.737
	Compliance	0.046	0.046	0.046	0.046	0.046	0.046	0.047	0.047
	Compliance_Cycle	0.046		0.046		0.046		0.047	
	Static Energy	5.271		4.409		4.738		4.480	
	Energy Dissipation	0.969		0.694		0.730		0.679	
Sensor 8	Umin	1.343	1.675	1.437	1.673	1.439	1.636	1.561	1.673
	Umax	4.790	4.787	4.793	4.804	4.733	4.788	4.797	4.797
	Compliance	0.289	0.253	0.295	0.277	0.288	0.263	0.281	0.296
	Compliance_Cycle	0.270		0.285		0.275		0.288	
	Static Energy	31.630		28.659		29.828		28.856	
	Energy Dissipation	5.675		4.345		4.240		4.099	
Sensor 9	Umin	0.195	0.348	-0.062	0.350	-0.056	0.254	0.135	0.292
	Umax	4.941	4.986	4.945	4.986	4.929	4.986	4.849	4.955
	Compliance	0.416	0.388	0.458	0.422	0.450	0.406	0.418	0.463
	Compliance_Cycle	0.401		0.439		0.427		0.439	
	Static Energy	32.924		30.114		31.412		29.807	
	Energy Dissipation	6.443		7.901		7.418		7.193	
Sensor 10	Umin	0.881	1.082	0.918	1.037	0.945	1.085	0.995	1.089
	Umax	4.370	4.375	4.035	4.035	4.140	4.156	4.081	4.038
	Compliance	0.254	0.258	0.250	0.258	0.251	0.258	0.258	0.262
	Compliance_Cycle	0.256		0.254		0.254		0.260	
	Static Energy	28.889		24.072		25.890		24.549	
	Energy Dissipation	5.194		3.813		3.889		3.547	

Config 8 Series 2 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.49	0.49	0.59	0.59	0.66	0.66	0.68
	Fmax	12.34	12.34	12.44	12.44	12.48	12.48	13.19	13.19
Sensor 1	Umin	-0.003	0.012	0.005	0.017	0.003	0.037	0.027	0.049
	Umax	0.394	0.394	0.394	0.394	0.395	0.403	0.420	0.420
	Compliance	0.033	0.033	0.033	0.033	0.033	0.031	0.031	0.031
	Compliance_Cycle	0.033		0.033		0.032		0.031	
	Static Energy	2.352		2.336		2.382		2.627	
	Energy Dissipation	0.445		0.391		0.492		0.485	
Sensor 2	Umin	-0.012	0.313	0.220	0.339	0.220	0.358	0.277	0.425
	Umax	4.139	4.139	4.177	4.179	4.188	4.226	4.463	4.468
	Compliance	0.340	0.337	0.329	0.342	0.328	0.346	0.329	0.347
	Compliance_Cycle	0.339		0.335		0.336		0.338	
	Static Energy	24.585		24.767		24.967		27.954	
	Energy Dissipation	5.865		5.135		5.009		5.791	
Sensor 3	Umin	0.000	0.681	0.418	0.645	0.442	0.714	0.550	0.937
	Umax	8.731	8.828	8.666	8.789	8.643	8.844	9.494	9.539
	Compliance	0.708	0.719	0.682	0.731	0.680	0.739	0.688	0.743
	Compliance_Cycle	0.713		0.705		0.708		0.715	
	Static Energy	52.291		52.088		52.250		59.682	
	Energy Dissipation	13.855		12.268		11.557		13.826	
Sensor 4	Umin	0.001	0.053	0.041	0.065	0.049	0.075	0.067	0.101
	Umax	0.629	0.620	0.643	0.643	0.654	0.656	0.710	0.696
	Compliance	0.052	0.049	0.050	0.050	0.050	0.050	0.050	0.050
	Compliance_Cycle	0.050		0.050		0.050		0.050	
	Static Energy	3.728		3.810		3.873		4.442	
	Energy Dissipation	0.782		0.662		0.678		0.833	
Sensor 5	Umin	-0.002	0.295	0.195	0.331	0.206	0.347	0.259	0.410
	Umax	3.918	3.929	3.937	3.937	3.914	3.922	4.239	4.272
	Compliance	0.317	0.319	0.304	0.321	0.304	0.327	0.306	0.329
	Compliance_Cycle	0.318		0.313		0.315		0.317	
	Static Energy	23.285		23.333		23.171		26.728	
	Energy Dissipation	6.258		5.488		5.297		6.301	
Sensor 6	Umin	-0.044	0.587	0.326	0.637	0.331	0.609	0.406	0.755
	Umax	6.877	7.129	6.638	6.799	6.485	7.078	7.467	7.646
	Compliance	0.532	0.564	0.500	0.561	0.499	0.579	0.505	0.586
	Compliance_Cycle	0.548		0.529		0.536		0.542	
	Static Energy	42.489		40.294		41.816		47.838	
	Energy Dissipation	15.698		13.781		13.014		16.082	
Sensor 7	Umin	-0.002	0.039	0.029	0.044	0.030	0.047	0.038	0.053
	Umax	0.579	0.573	0.584	0.584	0.585	0.589	0.624	0.612
	Compliance	0.048	0.046	0.046	0.047	0.046	0.047	0.046	0.047
	Compliance_Cycle	0.047		0.047		0.047		0.047	
	Static Energy	3.438		3.462		3.479		3.903	
	Energy Dissipation	0.726		0.627		0.633		0.702	
Sensor 8	Umin	-0.004	0.273	0.193	0.314	0.200	0.318	0.264	0.379
	Umax	4.153	4.129	4.198	4.200	4.206	4.230	4.485	4.434
	Compliance	0.344	0.337	0.333	0.343	0.332	0.345	0.331	0.346
	Compliance_Cycle	0.341		0.338		0.338		0.338	
	Static Energy	24.622		24.891		24.991		28.061	
	Energy Dissipation	5.781		5.098		4.971		5.654	
Sensor 9	Umin	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
	Umax	5.877	5.875	5.871	5.880	5.904	5.967	6.170	6.161
	Compliance	0.519	0.532	0.524	0.543	0.528	0.547	0.513	0.548
	Compliance_Cycle	0.526		0.533		0.537		0.529	
	Static Energy	34.812		34.849		35.253		38.603	
	Energy Dissipation	3.919		6.105		5.933		7.108	
Sensor 10	Umin	-0.001	0.210	0.175	0.239	0.172	0.202	0.183	0.280
	Umax	3.167	3.149	3.181	3.182	3.188	3.214	3.454	3.392
	Compliance	0.260	0.255	0.250	0.258	0.250	0.262	0.252	0.265
	Compliance_Cycle	0.258		0.254		0.256		0.258	
	Static Energy	18.763		18.858		18.988		21.610	
	Energy Dissipation	3.993		3.314		3.671		4.229	

Config 8 Series 2 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.68	0.62	0.62	0.58	0.58	0.57	0.57	0.69
	Fmax	12.70	12.70	12.72	12.72	12.65	12.65	12.39	12.39
Sensor 1	Umin	0.034	0.022	0.008	0.043	0.023	0.044	0.037	0.052
	Umax	0.400	0.400	0.406	0.406	0.400	0.400	0.395	0.395
	Compliance	0.030	0.032	0.032	0.031	0.031	0.031	0.031	0.030
	Compliance_Cycle	0.031		0.031		0.031		0.031	
	Static Energy	2.417		2.467		2.419		2.311	
	Energy Dissipation	0.445		0.488		0.487		0.396	
Sensor 2	Umin	0.275	0.260	0.224	0.364	0.212	0.380	0.303	0.443
	Umax	4.272	4.272	4.298	4.303	4.303	4.304	4.213	4.216
	Compliance	0.325	0.352	0.328	0.344	0.332	0.352	0.328	0.341
	Compliance_Cycle	0.338		0.336		0.342		0.335	
	Static Energy	25.811		26.127		26.006		24.663	
	Energy Dissipation	5.334		5.387		5.325		5.004	
Sensor 3	Umin	0.544	0.392	0.453	0.708	0.450	0.727	0.592	0.888
	Umax	8.839	8.909	8.923	9.009	9.150	9.148	8.986	9.002
	Compliance	0.675	0.753	0.684	0.735	0.694	0.756	0.688	0.734
	Compliance_Cycle	0.712		0.709		0.724		0.710	
	Static Energy	53.828		54.702		55.288		52.661	
	Energy Dissipation	12.036		12.650		12.452		11.942	
Sensor 4	Umin	0.081	0.083	0.076	0.113	0.086	0.125	0.113	0.142
	Umax	0.693	0.693	0.704	0.705	0.709	0.700	0.706	0.693
	Compliance	0.049	0.051	0.050	0.050	0.050	0.051	0.050	0.050
	Compliance_Cycle	0.050		0.050		0.051		0.050	
	Static Energy	4.189		4.279		4.286		4.128	
	Energy Dissipation	0.757		0.715		0.736		0.631	
Sensor 5	Umin	0.268	0.286	0.221	0.360	0.225	0.383	0.308	0.452
	Umax	3.995	3.995	4.026	4.029	4.149	4.152	4.050	4.044
	Compliance	0.297	0.333	0.303	0.324	0.309	0.335	0.306	0.323
	Compliance_Cycle	0.314		0.313		0.321		0.314	
	Static Energy	24.138		24.464		25.088		23.692	
	Energy Dissipation	5.714		5.731		5.728		5.487	
Sensor 6	Umin	0.419	0.378	0.308	0.572	0.354	0.608	0.443	0.775
	Umax	6.516	6.854	6.619	7.179	7.351	7.396	7.176	7.244
	Compliance	0.471	0.592	0.490	0.574	0.513	0.605	0.508	0.576
	Compliance_Cycle	0.525		0.529		0.555		0.539	
	Static Energy	41.412		43.590		44.690		42.377	
	Energy Dissipation	13.662		14.777		14.435		14.639	
Sensor 7	Umin	0.036	0.036	0.032	0.049	0.029	0.050	0.041	0.059
	Umax	0.597	0.597	0.599	0.600	0.597	0.591	0.585	0.576
	Compliance	0.046	0.048	0.046	0.047	0.046	0.048	0.046	0.047
	Compliance_Cycle	0.047		0.046		0.047		0.046	
	Static Energy	3.608		3.641		3.608		3.425	
	Energy Dissipation	0.667		0.666		0.660		0.619	
Sensor 8	Umin	0.252	0.265	0.185	0.322	0.185	0.326	0.267	0.375
	Umax	4.292	4.292	4.335	4.337	4.304	4.284	4.229	4.182
	Compliance	0.326	0.352	0.334	0.345	0.337	0.353	0.335	0.343
	Compliance_Cycle	0.339		0.339		0.345		0.339	
	Static Energy	25.932		26.334		26.006		24.739	
	Energy Dissipation	5.249		5.425		5.343		4.954	
Sensor 9	Umin	0.000	0.004	0.001	0.000	0.001	0.001	0.001	0.004
	Umax	5.918	5.944	6.067	6.081	6.082	6.083	5.988	5.995
	Compliance	0.511	0.551	0.516	0.546	0.516	0.568	0.521	0.544
	Compliance_Cycle	0.530		0.531		0.541		0.532	
	Static Energy	35.914		36.923		36.756		35.070	
	Energy Dissipation	6.791		6.665		6.410		7.588	
Sensor 10	Umin	0.195	0.103	0.160	0.275	0.167	0.262	0.214	0.306
	Umax	3.276	3.276	3.277	3.285	3.260	3.244	3.196	3.157
	Compliance	0.249	0.268	0.250	0.259	0.253	0.269	0.252	0.259
	Compliance_Cycle	0.258		0.255		0.260		0.255	
	Static Energy	19.794		19.946		19.698		18.696	
	Energy Dissipation	4.233		3.662		3.810		3.502	

Config 8 Series 3 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.69	0.69	0.68	0.68	0.43	0.43	0.67
	Fmax	13.38	13.38	13.54	13.54	13.36	13.36	12.80	12.80
Sensor 1	Umin	-0.006	0.016	0.005	0.027	0.005	0.016	0.003	0.018
	Umax	0.415	0.416	0.421	0.422	0.416	0.416	0.402	0.405
	Compliance	0.032	0.033	0.032	0.033	0.032	0.033	0.033	0.033
	Compliance_Cycle	0.032		0.032		0.033		0.033	
	Static Energy	2.678		2.710		2.686		2.455	
	Energy Dissipation	0.486		0.469		0.434		0.405	
Sensor 2	Umin	-0.023	0.356	0.252	0.421	0.236	0.342	0.259	0.381
	Umax	4.483	4.514	4.559	4.560	4.487	4.487	4.280	4.310
	Compliance	0.335	0.346	0.325	0.340	0.325	0.349	0.327	0.343
	Compliance_Cycle	0.340		0.332		0.336		0.335	
	Static Energy	28.798		29.311		29.002		26.149	
	Energy Dissipation	6.452		5.973		5.452		5.110	
Sensor 3	Umin	-0.089	0.691	0.502	0.781	0.445	0.724	0.481	0.737
	Umax	9.340	9.555	9.467	9.673	9.294	9.340	8.858	9.181
	Compliance	0.700	0.741	0.677	0.727	0.680	0.745	0.684	0.735
	Compliance_Cycle	0.720		0.701		0.711		0.709	
	Static Energy	61.211		62.176		60.370		55.702	
	Energy Dissipation	15.213		13.645		12.479		11.901	
Sensor 4	Umin	0.001	0.069	0.052	0.101	0.068	0.100	0.077	0.113
	Umax	0.690	0.691	0.720	0.719	0.725	0.725	0.704	0.706
	Compliance	0.051	0.050	0.050	0.049	0.049	0.051	0.050	0.050
	Compliance_Cycle	0.050		0.049		0.050		0.050	
	Static Energy	4.388		4.625		4.684		4.283	
	Energy Dissipation	0.952		0.896		0.843		0.725	
Sensor 5	Umin	-0.028	0.336	0.231	0.404	0.229	0.332	0.256	0.368
	Umax	4.208	4.245	4.344	4.344	4.192	4.224	4.028	4.095
	Compliance	0.309	0.328	0.304	0.323	0.301	0.331	0.301	0.325
	Compliance_Cycle	0.318		0.313		0.315		0.313	
	Static Energy	27.120		27.922		27.302		24.845	
	Energy Dissipation	6.911		6.423		5.939		5.678	
Sensor 6	Umin	-0.100	0.548	0.338	0.633	0.307	0.546	0.377	0.549
	Umax	7.035	7.457	7.425	7.844	6.842	7.333	6.592	7.325
	Compliance	0.501	0.581	0.501	0.578	0.490	0.592	0.482	0.581
	Compliance_Cycle	0.538		0.537		0.537		0.527	
	Static Energy	47.964		50.419		47.398		44.441	
	Energy Dissipation	17.346		16.055		14.361		14.755	
Sensor 7	Umin	0.001	0.049	0.035	0.061	0.034	0.046	0.039	0.055
	Umax	0.628	0.629	0.638	0.638	0.629	0.629	0.603	0.604
	Compliance	0.047	0.047	0.046	0.046	0.045	0.048	0.046	0.047
	Compliance_Cycle	0.047		0.046		0.047		0.046	
	Static Energy	3.990		4.102		4.066		3.666	
	Energy Dissipation	0.787		0.740		0.712		0.665	
Sensor 8	Umin	0.003	0.270	0.186	0.339	0.178	0.267	0.200	0.298
	Umax	4.469	4.484	4.531	4.532	4.466	4.467	4.278	4.302
	Compliance	0.329	0.346	0.328	0.339	0.325	0.350	0.328	0.342
	Compliance_Cycle	0.337		0.333		0.337		0.335	
	Static Energy	28.459		29.131		28.873		26.100	
	Energy Dissipation	6.293		6.097		5.656		5.165	
Sensor 9	Umin	0.000	0.002	0.002	0.003	0.003	0.002	0.003	0.002
	Umax	6.164	6.174	6.167	6.170	6.131	6.150	6.007	6.057
	Compliance	0.489	0.537	0.500	0.524	0.498	0.554	0.512	0.541
	Compliance_Cycle	0.512		0.512		0.525		0.526	
	Static Energy	39.189		39.659		39.751		36.748	
	Energy Dissipation	6.488		7.180		6.826		6.158	
Sensor 10	Umin	-0.001	0.244	0.176	0.332	0.179	0.262	0.189	0.295
	Umax	3.442	3.442	3.518	3.509	3.448	3.448	3.275	3.292
	Compliance	0.253	0.262	0.251	0.257	0.248	0.265	0.248	0.258
	Compliance_Cycle	0.257		0.254		0.256		0.253	
	Static Energy	21.849		22.613		22.286		19.973	
	Energy Dissipation	4.295		4.075		3.836		3.633	

Config 8 Series 3 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.67	0.68	0.68	0.68	0.68	0.63	0.63	0.69
	Fmax	12.40	12.40	13.63	13.63	13.40	13.40	13.56	13.56
Sensor 1	Umin	0.008	0.040	0.027	0.010	0.007	0.039	0.025	0.038
	Umax	0.386	0.386	0.429	0.429	0.416	0.417	0.423	0.423
	Compliance	0.032	0.030	0.030	0.033	0.032	0.031	0.030	0.031
	Compliance_Cycle	0.031		0.032		0.032		0.031	
	Static Energy	2.264		2.774		2.662		2.720	
	Energy Dissipation	0.439		0.418		0.532		0.529	
Sensor 2	Umin	0.284	0.400	0.261	0.361	0.258	0.360	0.217	0.375
	Umax	4.148	4.151	4.607	4.609	4.470	4.475	4.557	4.569
	Compliance	0.322	0.345	0.325	0.345	0.324	0.346	0.326	0.343
	Compliance_Cycle	0.333		0.335		0.334		0.334	
	Static Energy	24.330		29.839		28.577		29.398	
	Energy Dissipation	4.587		5.870		5.379		5.722	
Sensor 3	Umin	0.573	0.818	0.472	0.704	0.489	0.689	0.347	0.653
	Umax	8.561	8.636	9.560	9.620	9.180	9.413	9.449	9.530
	Compliance	0.671	0.739	0.680	0.739	0.675	0.743	0.680	0.737
	Compliance_Cycle	0.704		0.708		0.708		0.708	
	Static Energy	50.618		62.281		60.110		61.317	
	Energy Dissipation	10.328		13.851		12.284		13.599	
Sensor 4	Umin	0.095	0.120	0.097	0.123	0.116	0.145	0.126	0.162
	Umax	0.692	0.692	0.769	0.768	0.771	0.773	0.793	0.792
	Compliance	0.049	0.050	0.050	0.050	0.049	0.050	0.049	0.050
	Compliance_Cycle	0.050		0.050		0.050		0.050	
	Static Energy	4.055		4.975		4.936		5.099	
	Energy Dissipation	0.647		0.911		0.832		0.867	
Sensor 5	Umin	0.267	0.396	0.262	0.376	0.273	0.390	0.239	0.406
	Umax	3.896	3.897	4.377	4.388	4.196	4.199	4.289	4.303
	Compliance	0.298	0.326	0.303	0.327	0.299	0.328	0.304	0.323
	Compliance_Cycle	0.312		0.315		0.313		0.313	
	Static Energy	22.841		28.409		26.814		27.686	
	Energy Dissipation	4.990		6.329		6.007		5.873	
Sensor 6	Umin	0.365	0.635	0.344	0.562	0.364	0.600	0.249	0.583
	Umax	6.367	6.727	7.239	7.607	6.689	7.306	6.909	7.413
	Compliance	0.479	0.582	0.491	0.579	0.477	0.588	0.499	0.569
	Compliance_Cycle	0.525		0.531		0.527		0.532	
	Static Energy	39.429		49.249		46.655		47.696	
	Energy Dissipation	12.368		16.010		15.711		13.989	
Sensor 7	Umin	0.040	0.057	0.040	0.038	0.042	0.056	0.040	0.061
	Umax	0.586	0.586	0.645	0.645	0.635	0.635	0.643	0.643
	Compliance	0.045	0.047	0.045	0.047	0.045	0.047	0.046	0.047
	Compliance_Cycle	0.046		0.046		0.046		0.046	
	Static Energy	3.435		4.175		4.055		4.139	
	Energy Dissipation	0.609		0.729		0.705		0.722	
Sensor 8	Umin	0.215	0.322	0.217	0.289	0.211	0.320	0.198	0.346
	Umax	4.151	4.152	4.601	4.597	4.497	4.502	4.582	4.580
	Compliance	0.324	0.346	0.327	0.346	0.325	0.347	0.326	0.343
	Compliance_Cycle	0.334		0.336		0.336		0.335	
	Static Energy	24.336		29.788		28.749		29.481	
	Energy Dissipation	4.792		5.991		5.607		5.716	
Sensor 9	Umin	0.003	0.003	0.002	0.004	0.003	0.003	0.002	0.003
	Umax	5.865	5.884	6.159	6.163	6.157	6.164	6.160	6.174
	Compliance	0.503	0.557	0.499	0.528	0.505	0.545	0.502	0.537
	Compliance_Cycle	0.529		0.513		0.524		0.519	
	Static Energy	34.488		39.900		39.362		39.724	
	Energy Dissipation	7.233		7.383		5.619		6.103	
Sensor 10	Umin	0.237	0.308	0.230	0.268	0.225	0.304	0.236	0.341
	Umax	3.213	3.223	3.549	3.549	3.493	3.496	3.533	3.533
	Compliance	0.246	0.261	0.249	0.261	0.247	0.262	0.247	0.259
	Compliance_Cycle	0.253		0.255		0.254		0.253	
	Static Energy	18.891		22.977		22.325		22.732	
	Energy Dissipation	3.164		3.784		3.764		3.930	

Config 9 Series 1 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.63	0.63	0.61	0.61	0.55	0.55	0.68
	Fmax	11.00	11.00	12.70	12.70	12.41	12.41	12.34	12.34
Sensor 1 *	Umin	0.000	0.260	0.221	0.199	0.167	0.154	0.119	0.107
	Umax	0.449	0.463	0.408	0.403	0.366	0.358	0.308	0.304
	Compliance	0.046	0.017	0.017	0.022	0.018	0.017	0.017	0.016
	Compliance_Cycle	0.024		0.019		0.017		0.017	
	Static Energy	2.403		2.468		2.172		1.798	
	Energy Dissipation	1.806		0.016		0.020		0.001	
Sensor 2	Umin	-0.005	6.096	5.123	5.846	5.155	6.184	5.209	6.381
	Umax	14.770	16.560	17.060	17.060	16.890	16.900	16.900	16.920
	Compliance	1.495	0.840	1.009	1.163	1.000	0.977	0.996	0.954
	Compliance_Cycle	1.076		1.081		0.988		0.974	
	Static Energy	85.924		103.162		100.204		98.655	
	Energy Dissipation	77.185		39.988		37.354		36.590	
Sensor 3	Umin	-0.068	11.790	9.611	11.700	9.870	12.210	10.060	12.780
	Umax	31.100	35.290	36.410	36.460	35.900	36.350	35.980	36.340
	Compliance	3.100	1.878	2.253	2.567	2.209	2.198	2.205	2.144
	Compliance_Cycle	2.339		2.400		2.203		2.174	
	Static Energy	183.411		220.474		215.528		211.888	
	Energy Dissipation	159.860		92.117		85.918		84.203	
Sensor 4	Umin	0.001	-0.227	-0.295	-0.268	-0.304	-0.243	-0.295	-0.241
	Umax	0.855	0.984	0.902	0.894	0.877	0.879	0.872	0.872
	Compliance	0.083	0.103	0.103	0.110	0.102	0.099	0.102	0.099
	Compliance_Cycle	0.092		0.106		0.101		0.100	
	Static Energy	6.283		7.234		7.012		6.807	
	Energy Dissipation	0.819		2.350		2.220		2.125	
Sensor 5	Umin	0.010	6.466	5.544	6.237	5.653	6.634	5.723	6.820
	Umax	14.890	15.780	15.930	15.930	15.840	15.850	15.850	15.850
	Compliance	1.626	0.762	0.906	1.034	0.903	0.843	0.892	0.818
	Compliance_Cycle	1.037		0.966		0.872		0.853	
	Static Energy	81.855		96.329		93.979		92.417	
	Energy Dissipation	71.052		30.887		28.299		27.333	
Sensor 6	Umin	0.009	13.350	11.370	13.070	11.720	13.800	11.830	14.380
	Umax	27.860	27.740	27.640	27.610	27.640	27.640	27.660	27.630
	Compliance	3.257	1.277	1.533	1.848	1.522	1.388	1.492	1.305
	Compliance_Cycle	1.835		1.676		1.452		1.392	
	Static Energy	144.517		167.139		163.884		161.277	
	Energy Dissipation	130.535		50.973		46.528		44.924	
Sensor 7	Umin	0.001	0.442	0.349	0.402	0.343	0.447	0.356	0.464
	Umax	1.663	1.802	1.679	1.673	1.680	1.681	1.686	1.686
	Compliance	0.173	0.111	0.113	0.123	0.116	0.108	0.115	0.106
	Compliance_Cycle	0.135		0.118		0.112		0.111	
	Static Energy	9.347		10.153		9.967		9.831	
	Energy Dissipation	6.635		2.288		2.081		2.011	
Sensor 8	Umin	0.009	5.333	4.693	5.096	4.600	5.340	4.634	5.463
	Umax	5.597	5.642	5.625	5.660	5.542	5.657	5.607	5.656
	Compliance	0.624	0.023	0.088	0.121	0.087	0.031	0.082	0.024
	Compliance_Cycle	0.044		0.102		0.046		0.037	
	Static Energy	29.266		34.226		33.542		32.978	
	Energy Dissipation	18.540		0.936		1.184		1.088	
Sensor 9	Umin	0.004	5.028	4.233	5.019	3.929	5.209	3.761	5.034
	Umax	5.028	5.028	5.304	5.355	5.317	5.393	5.209	5.393
	Compliance	0.531	2.998	0.094	0.105	0.123	0.018	0.110	0.068
	Compliance_Cycle	0.903		0.099		0.032		0.084	
	Static Energy	26.081		32.382		31.976		31.445	
	Energy Dissipation	9.985		0.995		1.429		0.965	
Sensor 10	Umin	0.003	4.997	4.372	4.762	4.354	5.080	4.456	5.168
	Umax	10.990	12.070	12.330	12.330	12.250	12.270	12.240	12.240
	Compliance	1.128	0.569	0.678	0.771	0.676	0.645	0.669	0.632
	Compliance_Cycle	0.757		0.721		0.660		0.650	
	Static Energy	62.610		74.560		72.752		71.368	
	Energy Dissipation	55.328		25.008		23.427		22.678	

Config 9 Series 1 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.68	0.64	0.64	0.64	0.64	0.64	0.64	0.10
	Fmax	12.82	12.82	12.65	12.65	12.31	12.31	12.64	12.64
Sensor 1 *	Umin	0.074	0.051	0.026	-0.004	-0.023	-0.057	-0.086	-0.089
	Umax	0.263	0.256	0.205	0.204	0.153	0.147	0.111	0.101
	Compliance	0.017	0.017	0.016	0.017	0.016	0.016	0.016	0.015
	Compliance_Cycle	0.017		0.017		0.016		0.015	
	Static Energy	1.600		1.254		1.224		1.255	
	Energy Dissipation	-0.004		-0.026		0.012		0.066	
Sensor 2	Umin	5.405	6.399	5.664	6.468	5.765	6.352	5.633	6.858
	Umax	17.220	17.340	17.150	17.180	16.900	16.900	17.160	17.250
	Compliance	0.970	0.989	0.973	0.965	0.955	0.963	0.968	0.916
	Compliance_Cycle	0.979		0.969		0.959		0.941	
	Static Energy	105.596		103.192		98.580		108.188	
	Energy Dissipation	37.969		35.894		33.876		35.973	
Sensor 3	Umin	10.530	12.790	10.960	13.040	11.190	12.770	11.070	13.180
	Umax	36.800	37.440	36.620	37.030	35.970	36.300	36.710	37.370
	Compliance	2.147	2.212	2.167	2.162	2.107	2.158	2.148	2.067
	Compliance_Cycle	2.179		2.165		2.132		2.107	
	Static Energy	228.000		222.421		211.743		234.375	
	Energy Dissipation	87.040		82.810		78.051		82.365	
Sensor 4	Umin	-0.297	-0.231	-0.273	-0.228	-0.262	-0.231	-0.269	-0.172
	Umax	0.900	0.906	0.893	0.896	0.873	0.874	0.898	0.898
	Compliance	0.100	0.099	0.100	0.098	0.099	0.098	0.099	0.095
	Compliance_Cycle	0.099		0.099		0.098		0.097	
	Static Energy	7.321		7.021		6.628		7.317	
	Energy Dissipation	2.196		2.106		2.060		2.208	
Sensor 5	Umin	5.899	6.857	6.136	6.972	6.340	6.902	6.259	7.437
	Umax	16.010	16.060	16.050	16.060	15.870	15.870	16.060	16.070
	Compliance	0.870	0.847	0.866	0.825	0.846	0.821	0.845	0.773
	Compliance_Cycle	0.858		0.845		0.833		0.807	
	Static Energy	97.801		96.464		92.572		100.787	
	Energy Dissipation	27.686		27.153		24.951		26.995	
Sensor 6	Umin	12.220	14.470	12.770	14.630	13.040	14.360	12.920	14.970
	Umax	27.630	27.600	27.640	27.600	27.640	27.620	27.670	27.590
	Compliance	1.445	1.381	1.425	1.301	1.381	1.315	1.361	1.204
	Compliance_Cycle	1.412		1.360		1.347		1.278	
	Static Energy	168.260		166.020		161.228		173.539	
	Energy Dissipation	43.714		41.867		40.012		41.494	
Sensor 7	Umin	0.372	0.467	0.400	0.476	0.416	0.474	0.411	0.556
	Umax	1.719	1.725	1.715	1.717	1.697	1.697	1.724	1.724
	Compliance	0.115	0.109	0.114	0.107	0.113	0.107	0.112	0.102
	Compliance_Cycle	0.112		0.110		0.110		0.107	
	Static Energy	10.505		10.313		9.899		10.812	
	Energy Dissipation	2.024		1.907		1.831		2.012	
Sensor 8	Umin	4.764	5.415	4.901	5.455	4.995	5.457	4.978	5.537
	Umax	5.509	5.625	5.589	5.660	5.519	5.660	5.537	5.537
	Compliance	0.076	0.059	0.065	0.040	0.054	0.026	0.051	22.007
	Compliance_Cycle	0.066		0.050		0.035		0.102	
	Static Energy	34.255		33.997		33.016		34.727	
	Energy Dissipation	0.673		0.634		0.427		0.491	
Sensor 9	Umin	3.917	5.307	4.331	5.300	4.331	5.228	4.315	5.269
	Umax	5.333	5.393	5.332	5.392	5.300	5.337	5.337	5.269
	Compliance	0.141	0.016	0.096	0.014	0.092	0.024	0.088	1.443
	Compliance_Cycle	0.029		0.024		0.038		0.166	
	Static Energy	32.842		32.387		31.132		33.472	
	Energy Dissipation	1.131		0.633		0.570		0.615	
Sensor 10	Umin	4.529	5.185	4.725	5.225	4.825	5.187	4.807	5.727
	Umax	12.470	12.500	12.450	12.480	12.320	12.340	12.470	12.480
	Compliance	0.654	0.653	0.657	0.639	0.646	0.635	0.650	0.603
	Compliance_Cycle	0.653		0.647		0.640		0.625	
	Static Energy	76.122		74.961		71.981		78.271	
	Energy Dissipation	23.208		21.790		21.025		22.188	

Config 9 Series 2 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.70	0.70	0.70	0.70	0.64	0.64	0.65
	Fmax	12.30	12.30	12.61	12.61	12.54	12.54	12.47	12.47
Sensor 1 *	Umin	-0.003	0.000	-0.028	-0.053	-0.083	-0.106	-0.132	-0.173
	Umax	0.296	0.289	0.230	0.228	0.171	0.169	0.118	0.118
	Compliance	0.028	0.024	0.025	0.024	0.024	0.024	0.024	0.025
	Compliance_Cycle	0.025		0.024		0.024		0.025	
	Static Energy	1.736		1.686		1.645		1.722	
	Energy Dissipation	-0.086		0.017		0.013		0.010	
Sensor 2	Umin	-0.045	1.799	0.993	1.927	1.102	1.989	1.261	2.320
	Umax	13.000	13.060	13.300	13.310	13.240	13.250	13.230	13.340
	Compliance	1.118	1.014	1.046	1.042	1.030	1.065	1.022	1.075
	Compliance_Cycle	1.064		1.044		1.047		1.048	
	Static Energy	76.017		79.264		78.845		78.821	
	Energy Dissipation	42.181		38.374		37.251		37.631	
Sensor 3	Umin	-0.079	3.427	1.543	2.831	0.825	1.307	-0.442	-0.380
	Umax	28.250	28.650	28.270	28.540	26.800	27.160	24.720	25.420
	Compliance	2.421	2.256	2.257	2.364	2.196	2.457	2.131	2.511
	Compliance_Cycle	2.336		2.310		2.319		2.305	
	Static Energy	166.638		169.961		161.618		152.809	
	Energy Dissipation	91.736		83.543		77.803		72.439	
Sensor 4	Umin	-0.005	0.092	0.052	0.108	0.066	0.117	0.080	0.117
	Umax	1.239	1.239	1.254	1.254	1.251	1.251	1.250	1.255
	Compliance	0.107	0.102	0.104	0.101	0.102	0.102	0.102	0.105
	Compliance_Cycle	0.105		0.103		0.102		0.103	
	Static Energy	7.214		7.468		7.444		7.415	
	Energy Dissipation	2.338		2.200		2.125		2.090	
Sensor 5	Umin	-0.045	1.534	0.779	1.537	0.775	1.594	0.889	1.885
	Umax	12.200	12.200	12.270	12.280	12.220	12.230	12.220	12.260
	Compliance	1.090	0.967	1.022	0.994	1.009	1.016	1.004	1.034
	Compliance_Cycle	1.025		1.008		1.013		1.019	
	Static Energy	71.023		73.130		72.776		72.439	
	Energy Dissipation	37.471		33.749		33.491		33.490	
Sensor 6	Umin	-0.128	3.304	1.482	3.265	1.459	3.386	1.636	3.892
	Umax	23.650	23.650	23.590	23.590	23.560	23.580	23.550	23.590
	Compliance	2.188	1.892	2.040	1.962	2.020	2.021	2.003	2.090
	Compliance_Cycle	2.029		2.000		2.020		2.045	
	Static Energy	137.921		140.483		140.315		139.384	
	Energy Dissipation	84.719		75.284		74.236		73.659	
Sensor 7	Umin	-0.005	0.177	0.107	0.191	0.121	0.201	0.135	0.228
	Umax	1.479	1.479	1.500	1.500	1.498	1.499	1.501	1.507
	Compliance	0.132	0.115	0.124	0.116	0.122	0.118	0.122	0.119
	Compliance_Cycle	0.123		0.120		0.120		0.120	
	Static Energy	8.607		8.933		8.920		8.904	
	Energy Dissipation	2.349		2.046		1.993		2.078	
Sensor 8	Umin	0.000	1.358	0.672	1.470	0.783	1.444	0.871	1.918
	Umax	6.338	6.399	6.393	6.393	6.274	6.342	6.321	6.430
	Compliance	0.681	0.565	0.614	0.571	0.574	0.611	0.579	0.659
	Compliance_Cycle	0.618		0.592		0.592		0.616	
	Static Energy	37.117		38.072		37.739		37.992	
	Energy Dissipation	18.014		14.281		13.151		13.504	
Sensor 9	Umin	-0.097	0.990	-0.228	1.137	-0.113	0.915	0.078	1.532
	Umax	5.785	5.906	5.798	5.812	5.608	5.924	5.509	5.902
	Compliance	0.632	0.643	0.661	0.611	0.604	0.658	0.575	0.624
	Compliance_Cycle	0.638		0.635		0.630		0.599	
	Static Energy	34.822		35.972		35.923		34.873	
	Energy Dissipation	9.032		11.172		10.398		10.578	
Sensor 10	Umin	-0.038	1.225	0.718	1.298	0.797	1.357	0.886	1.573
	Umax	8.640	8.644	8.797	8.800	8.784	8.785	8.754	8.799
	Compliance	0.746	0.659	0.691	0.676	0.681	0.689	0.678	0.694
	Compliance_Cycle	0.700		0.683		0.685		0.686	
	Static Energy	50.360		52.406		52.276		51.990	
	Energy Dissipation	25.794		23.082		22.406		21.232	

Config 9 Series 2 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.65	0.67	0.67	0.45	0.45	0.67	0.67	0.69
	Fmax	12.86	12.86	12.78	12.78	12.58	12.58	12.82	12.82
Sensor 1 *	Umin	-0.184	-0.200	-0.201	-0.201	-0.201	-0.200	-0.200	-0.201
	Umax	0.058	0.057	0.001	0.000	0.000	0.000	0.000	0.000
	Compliance	0.024	0.023	0.020	0.018	0.014	0.012	0.009	0.007
	Compliance_Cycle	0.023		0.019		0.013		0.008	
	Static Energy	1.574		1.240		1.194		1.216	
	Energy Dissipation	-0.018		-0.082		-0.057		-0.169	
Sensor 2	Umin	1.429	2.350	1.646	1.813	1.576	2.281	1.536	2.355
	Umax	13.620	13.620	13.630	13.690	13.520	13.530	13.790	13.800
	Compliance	1.022	1.047	1.000	1.077	1.018	1.060	1.014	1.060
	Compliance_Cycle	1.034		1.037		1.038		1.037	
	Static Energy	82.998		84.383		80.554		83.683	
	Energy Dissipation	37.683		36.677		36.062		36.600	
Sensor 3	Umin	-0.998	-0.996	-0.996	-0.993	-0.993	-0.983	-0.983	-0.851
	Umax	22.510	22.910	18.570	19.060	13.840	13.950	9.746	9.812
	Compliance	2.012	2.324	1.668	1.934	1.288	1.542	0.926	1.123
	Compliance_Cycle	2.157		1.791		1.404		1.015	
	Static Energy	145.692		123.620		88.964		65.461	
	Energy Dissipation	69.047		56.615		42.400		27.998	
Sensor 4	Umin	0.066	0.140	0.104	0.115	0.102	0.109	0.068	0.152
	Umax	1.279	1.279	1.282	1.282	1.271	1.271	1.288	1.290
	Compliance	0.104	0.099	0.100	0.101	0.101	0.105	0.103	0.101
	Compliance_Cycle	0.102		0.100		0.103		0.102	
	Static Energy	7.794		7.902		7.567		7.822	
	Energy Dissipation	2.271		2.033		1.967		2.319	
Sensor 5	Umin	0.995	1.686	1.008	1.186	0.932	1.630	0.910	1.669
	Umax	12.350	12.360	12.340	12.340	12.270	12.280	12.350	12.360
	Compliance	0.996	1.004	0.993	1.038	1.008	1.018	0.996	1.005
	Compliance_Cycle	1.000		1.015		1.013		1.001	
	Static Energy	75.320		76.062		73.112		74.950	
	Energy Dissipation	32.487		32.396		32.979		32.494	
Sensor 6	Umin	1.886	3.526	1.890	2.440	1.715	3.453	1.716	3.358
	Umax	23.500	23.500	23.480	23.480	23.510	23.530	23.510	23.510
	Compliance	1.975	1.994	1.971	2.078	2.009	2.007	1.976	1.991
	Compliance_Cycle	1.984		2.023		2.008		1.983	
	Static Energy	143.205		144.727		140.092		142.563	
	Energy Dissipation	70.930		70.106		72.628		69.277	
Sensor 7	Umin	0.146	0.216	0.154	0.170	0.149	0.221	0.152	0.233
	Umax	1.520	1.520	1.523	1.520	1.513	1.513	1.534	1.535
	Compliance	0.121	0.115	0.122	0.118	0.123	0.117	0.122	0.116
	Compliance_Cycle	0.118		0.120		0.120		0.119	
	Static Energy	9.263		9.388		9.008		9.308	
	Energy Dissipation	1.947		1.919		1.961		1.965	
Sensor 8	Umin	1.060	1.618	1.040	1.186	1.037	1.672	1.030	1.737
	Umax	6.302	6.409	6.211	6.430	6.334	6.392	6.390	6.430
	Compliance	0.552	0.613	0.574	0.615	0.579	0.517	0.599	0.565
	Compliance_Cycle	0.581		0.594		0.546		0.581	
	Static Energy	39.055		39.634		38.056		38.991	
	Energy Dissipation	11.990		11.592		12.845		12.671	
Sensor 9	Umin	0.385	1.223	0.155	0.469	0.154	1.261	0.131	1.368
	Umax	5.688	5.816	5.890	5.924	5.723	5.924	5.838	5.838
	Compliance	0.557	0.650	0.642	0.675	0.630	0.533	0.656	0.574
	Compliance_Cycle	0.600		0.658		0.577		0.612	
	Static Energy	35.442		36.515		35.270		35.401	
	Energy Dissipation	8.819		9.295		11.162		10.868	
Sensor 10	Umin	0.819	1.459	1.009	1.115	0.979	1.428	0.942	1.492
	Umax	8.929	8.932	8.910	8.911	8.844	8.853	8.964	8.988
	Compliance	0.674	0.683	0.668	0.706	0.679	0.690	0.671	0.685
	Compliance_Cycle	0.678		0.687		0.684		0.678	
	Static Energy	54.430		54.926		52.709		54.503	
	Energy Dissipation	22.327		21.819		21.751		22.292	

Config 9 Series 3 Table A	Loading / Unloading	1	2	3	4	5	6	7	8
	Fmin	0.00	0.66	0.66	0.58	0.58	0.68	0.68	0.66
	Fmax	12.27	12.27	12.31	12.31	12.50	12.50	12.27	12.27
Sensor 1 *	Umin	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Umax	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Compliance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Compliance_Cycle	0.000		0.000		0.000		0.000	
	Static Energy	0.001		0.000		0.001		0.001	
	Energy Dissipation	0.000		0.000		0.000		0.000	
Sensor 2	Umin	-0.015	1.883	0.919	1.786	1.460	2.151	1.359	1.952
	Umax	12.360	12.380	12.420	12.420	12.630	12.640	12.380	12.380
	Compliance	1.044	0.914	0.981	0.945	0.980	0.914	0.942	0.941
	Compliance_Cycle	0.974		0.962		0.946		0.942	
	Static Energy	71.941		72.874		74.697		71.884	
	Energy Dissipation	40.320		35.741		34.372		33.472	
Sensor 3	Umin	-0.082	4.538	1.955	4.058	3.257	4.817	3.073	4.553
	Umax	27.080	27.390	27.250	27.690	28.070	28.140	27.410	27.870
	Compliance	2.277	2.006	2.134	2.094	2.165	2.041	2.069	2.101
	Compliance_Cycle	2.133		2.114		2.101		2.085	
	Static Energy	159.446		162.470		166.295		161.826	
	Energy Dissipation	93.581		84.177		81.173		78.858	
Sensor 4	Umin	-0.003	0.146	0.100	0.148	0.130	0.176	0.127	0.164
	Umax	1.246	1.246	1.246	1.247	1.257	1.258	1.245	1.245
	Compliance	0.107	0.097	0.100	0.097	0.100	0.095	0.097	0.096
	Compliance_Cycle	0.102		0.098		0.098		0.097	
	Static Energy	7.251		7.317		7.434		7.229	
	Energy Dissipation	2.483		1.963		1.896		1.855	
Sensor 5	Umin	-0.010	1.799	0.956	1.774	1.454	2.181	1.405	1.958
	Umax	11.990	11.990	12.020	12.020	12.120	12.120	12.010	12.010
	Compliance	1.051	0.882	0.981	0.914	0.977	0.868	0.943	0.905
	Compliance_Cycle	0.959		0.946		0.919		0.923	
	Static Energy	69.649		70.527		71.624		69.735	
	Energy Dissipation	36.560		31.918		30.140		29.656	
Sensor 6	Umin	-0.086	3.855	1.918	3.727	2.963	4.490	2.860	4.068
	Umax	22.820	22.810	22.810	22.820	22.780	22.780	22.770	22.770
	Compliance	2.080	1.661	1.920	1.752	1.925	1.641	1.844	1.731
	Compliance_Cycle	1.847		1.832		1.772		1.786	
	Static Energy	132.946		133.895		134.620		132.213	
	Energy Dissipation	78.418		67.960		62.480		62.477	
Sensor 7	Umin	0.000	0.166	0.090	0.169	0.143	0.217	0.137	0.195
	Umax	1.408	1.408	1.408	1.407	1.417	1.417	1.404	1.403
	Compliance	0.124	0.105	0.116	0.107	0.114	0.102	0.112	0.105
	Compliance_Cycle	0.114		0.111		0.108		0.109	
	Static Energy	8.172		8.261		8.374		8.152	
	Energy Dissipation	2.165		1.847		1.770		1.701	
Sensor 8	Umin	-0.009	1.554	0.788	1.582	1.308	2.027	1.293	1.809
	Umax	5.376	5.744	5.590	5.744	5.520	5.657	5.638	5.661
	Compliance	0.565	0.355	0.478	0.419	0.446	0.375	0.437	0.428
	Compliance_Cycle	0.436		0.447		0.407		0.432	
	Static Energy	33.389		33.703		33.430		32.870	
	Energy Dissipation	13.677		10.291		8.797		8.594	
Sensor 9	Umin	-0.047	2.116	0.825	2.285	1.794	2.776	1.833	2.475
	Umax	5.602	6.104	5.955	5.955	5.881	6.061	5.893	6.019
	Compliance	0.591	0.335	0.495	0.397	0.435	0.346	0.406	0.408
	Compliance_Cycle	0.428		0.440		0.385		0.407	
	Static Energy	35.703		34.941		35.818		34.949	
	Energy Dissipation	12.356		6.612		5.068		3.553	
Sensor 10	Umin	-0.001	1.262	0.746	1.289	1.096	1.580	1.004	1.417
	Umax	8.428	8.432	8.444	8.444	8.538	8.540	8.427	8.427
	Compliance	0.712	0.611	0.665	0.628	0.659	0.604	0.637	0.623
	Compliance_Cycle	0.658		0.646		0.630		0.630	
	Static Energy	48.945		49.545		50.468		48.931	
	Energy Dissipation	25.269		22.102		21.284		20.649	

Config 9 Series 3 Table B	Loading / Unloading	9	10	11	12	13	14	15	16
	Fmin	0.66	0.67	0.67	0.57	0.57	0.69	0.69	0.68
	Fmax	11.58	11.58	11.35	11.35	12.29	12.29	12.43	12.43
Sensor 1 *	Umin	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Umax	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Compliance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Compliance_Cycle	0.000		0.000		0.000		0.000	
	Static Energy	0.001		0.001		0.000		0.000	
	Energy Dissipation	0.001		0.000		0.000		0.000	
Sensor 2	Umin	1.327	2.087	1.167	1.840	1.270	2.098	1.262	1.992
	Umax	11.870	12.330	11.630	12.750	12.350	12.420	12.440	12.470
	Compliance	0.944	0.873	0.972	0.812	0.967	0.942	0.950	0.993
	Compliance_Cycle	0.907		0.885		0.954		0.971	
	Static Energy	67.247		68.721		72.025		73.262	
	Energy Dissipation	33.304		35.829		34.083		33.895	
Sensor 3	Umin	3.053	4.932	2.730	4.465	3.032	5.079	3.098	4.930
	Umax	26.560	27.580	26.010	28.880	27.330	28.040	27.750	28.060
	Compliance	2.072	1.957	2.136	1.822	2.125	2.096	2.088	2.215
	Compliance_Cycle	2.013		1.966		2.110		2.150	
	Static Energy	150.420		155.659		162.608		164.854	
	Energy Dissipation	78.118		84.186		79.885		79.684	
Sensor 4	Umin	0.129	0.180	0.126	0.164	0.130	0.188	0.141	0.182
	Umax	1.199	1.239	1.185	1.275	1.259	1.259	1.275	1.277
	Compliance	0.098	0.093	0.100	0.089	0.099	0.096	0.097	0.099
	Compliance_Cycle	0.095		0.094		0.097		0.098	
	Static Energy	6.757		6.872		7.301		7.502	
	Energy Dissipation	1.855		1.924		1.902		1.835	
Sensor 5	Umin	1.385	2.097	1.198	1.794	1.267	2.079	1.280	2.032
	Umax	11.760	11.980	11.630	12.180	12.040	12.050	12.100	12.100
	Compliance	0.953	0.841	0.991	0.769	0.971	0.911	0.950	0.955
	Compliance_Cycle	0.894		0.866		0.940		0.952	
	Static Energy	65.338		65.648		69.880		71.088	
	Energy Dissipation	30.035		30.820		30.795		30.545	
Sensor 6	Umin	2.754	4.378	2.352	3.566	2.383	4.183	2.389	4.104
	Umax	22.770	22.770	22.820	22.760	22.740	22.730	22.740	22.740
	Compliance	1.875	1.602	1.979	1.416	1.918	1.752	1.860	1.839
	Compliance_Cycle	1.728		1.651		1.831		1.850	
	Static Energy	124.186		122.996		131.873		133.599	
	Energy Dissipation	64.013		62.863		65.848		64.976	
Sensor 7	Umin	0.138	0.210	0.124	0.188	0.138	0.219	0.143	0.216
	Umax	1.364	1.402	1.356	1.442	1.422	1.422	1.434	1.434
	Compliance	0.114	0.100	0.121	0.094	0.114	0.106	0.114	0.110
	Compliance_Cycle	0.107		0.106		0.110		0.112	
	Static Energy	7.646		7.772		8.246		8.425	
	Energy Dissipation	1.722		1.843		1.750		1.741	
Sensor 8	Umin	1.285	1.999	1.183	1.686	1.209	1.972	1.227	1.980
	Umax	5.685	5.744	5.672	5.744	5.635	5.635	5.409	5.744
	Compliance	0.467	0.339	0.537	0.285	0.447	0.390	0.428	0.401
	Compliance_Cycle	0.393		0.372		0.417		0.414	
	Static Energy	31.327		30.959		32.678		33.746	
	Energy Dissipation	9.213		9.436		9.507		8.476	
Sensor 9	Umin	1.675	2.622	1.746	2.358	1.533	2.401	1.585	2.390
	Umax	5.912	6.107	6.060	6.107	5.866	6.107	5.735	5.850
	Compliance	0.443	0.306	0.528	0.284	0.433	0.414	0.431	0.393
	Compliance_Cycle	0.362		0.369		0.423		0.411	
	Static Energy	33.307		32.916		35.415		34.369	
	Energy Dissipation	4.611		5.995		6.154		5.271	
Sensor 10	Umin	1.017	1.505	0.942	1.336	1.001	1.522	1.033	1.504
	Umax	8.064	8.420	7.954	8.668	8.473	8.473	8.582	8.593
	Compliance	0.639	0.578	0.656	0.540	0.653	0.624	0.643	0.658
	Compliance_Cycle	0.607		0.593		0.638		0.650	
	Static Energy	45.922		46.719		49.136		50.484	
	Energy Dissipation	20.771		22.284		21.047		20.917	