Getting an education in Mongolia is a challenge. In winter, temperatures drop to below -45°C; during extreme ‘dzud’ winters, even lower. In a country that is criss-crossed with active seismic faults, few buildings have been designed with earthquakes in mind. Rapid urbanisation means there is a chronic shortage of space in schools.

Lean School is a blueprint for overcoming these challenges. The triangular section is a passive design response to the extreme environment. It reduces exposure to prevailing northerly winds while harvesting solar energy on its south elevation. The highly insulated, sealed envelope minimises heating energy demands.

The pitched form creates an efficient seismic-resilient stability system. The inclined plane of the roof is formed of a stiff steel diagrid, the pitch allowing one side of the grid to be firmly anchored into the foundation. This removes the need for bracing or complicated connections. This offers flexibility and simplicity, redundancy and safety, while reducing cost.

The school structure works on a simple, repeating grid. This future-proofs the design against the need to expand. The pitched form allows buildings to be closely spaced without overshadowing, allowing optimal use of available sites, however constrained.

Lean School is integrated into its landscape. The ‘Cool grounds’ are designed to maximise sports activities with minimal vertical interventions. The grounds are kept free from clutter to allow children to play.
The site sits between the vegetated river edge to the west, a linear tree planted ‘boulevard’ and two public squares to the north. The concept builds on the site’s context by pulling the river edge and creating a continuous green corridor that weaves around the Lean School and links it to its surroundings.

The site will be defined by two edges, a ‘River’ edge and a ‘Town’ edge. The ‘River’ edge will be characterised by a densely planted buffer, whilst the ‘Town’ edge will be characterised by an interactive wall.

The site will be divided into 5 zones:
- A – Transition zone: a pedestrian zone between the street and the arrival space to the school
- B – Arrival zone: a zone to drop off and pick up the children to and from school, but also a gathering and waiting space for the parents.
- C – ‘Cool’ grounds: the main school grounds framed by the existing and proposed buildings.
- D – Landscape buffer zone: a densely planted zone that provides a setting for the different structures currently on site.
- E – Service zone: a zone that could currently be used for servicing the school, but that can be repurposed to create larger play grounds.

The landscape buffer is characterised by densely planted trees and understory planting and will wrap around the existing structures to create a setting and also to ground them to the site.

The children’s gardens are proposed as learning grounds with a focus on greening the urban environment through education and sustainable practices. The gardens can become part of the school curriculum to teach science or ecology lessons, latest farming technologies etc.

Large, bright classrooms provide a suitably warm, flexible space for children to learn.

The corridor is an internal street, accommodating classrooms, a multi-purpose space with a linear plenum preheating incoming air which doubling as a seating alcove and storage wall.

The skylit gymnasium provides a flexible, multipurpose space for playing and learning. The gym is able to serve as a community gathering space or auditorium as required.

In addition to sports, the grounds can serve as outdoor classrooms, allow for outdoor film screening, outdoor theatre, and end of year school exhibitions.

Hard standing surface and simply painting lines in the ground create a diversity of sports activities. Sports include a running track, mini basketball and/or football. Gymnastic bars are also proposed in the grounds as well as soft landscape surfaces.

The corridor is an internal street, accommodating classrooms, a multi-purpose space with a linear plenum preheating incoming air which doubling as a seating alcove and storage wall.

The skylit gymnasium provides a flexible, multipurpose space for playing and learning. The gym is able to serve as a community gathering space or auditorium as required.

In addition to sports, the grounds can serve as outdoor classrooms, allow for outdoor film screening, outdoor theatre, and end of year school exhibitions.

Hard standing surface and simply painting lines in the ground create a diversity of sports activities. Sports include a running track, mini basketball and/or football. Gymnastic bars are also proposed in the grounds as well as soft landscape surfaces.

The skylit gymnasium provides a flexible, multipurpose space for playing and learning. The gym is able to serve as a community gathering space or auditorium as required.

In addition to sports, the grounds can serve as outdoor classrooms, allow for outdoor film screening, outdoor theatre, and end of year school exhibitions.

Hard standing surface and simply painting lines in the ground create a diversity of sports activities. Sports include a running track, mini basketball and/or football. Gymnastic bars are also proposed in the grounds as well as soft landscape surfaces.
**Lean School**

**Materials, Structure & Assembly**

Modular forms of construction are proposed, allowing the prototype school to be configured in a number of ways to suit local requirements.

Through construction of the school, local labour will learn techniques appropriate for seismically active regions, knowledge that can be used to reduce the seismic hazard in other buildings.

Concrete serves as a structural bracing element for the roof structure and also contains radiant heating pipes. A seat wall formed from the concrete provides an active edge to the internal street.

**The Winter Mode**

During winter, the sun’s angle is at its minimum. Large expanses of south-facing glazing maximise solar insulation and heat gains into the classrooms. Thick insulated curtains will reduce thermal loss through the glazing in the late afternoon and overnight.

Incoming air is preheated in a dedicated space below raked seating in the gymnasium / internal street and is distributed to the main spaces. Well insulated, large ducts reduce energy required to pump the air and reduce heat loss to the building fabric through the duct.

Underfloor heating uses low-grade heat to heat up the space from the ground up, ideal for large volume spaces. Pipes are embedded into the floor slab to maximize comfort through the high thermal mass concrete. Voids in structural beams are used as risers for hot water pipework.

Solar PV & solar thermal collection panels line the south facing facade, supplying electricity and hot water for heating and domestic use. Natural daylighting will be supplemented with LED light fittings that are powered by photo voltaic panels.

**The Summer Mode**

During summer months, when the sun is at its highest, solar gains are reduced through shading provided by the integrated overhang. Operable windows open so that cross-ventilation of the building can be achieved.

The spaces are predominantly naturally lit with north facing rooflights and south facing windows.

Water run-off from the roof is harvested for toilet flushing and irrigation.

Acoustic separation between spaces and acoustic absorption is to be provided with perforated solid panels to the roof to achieve a comfortable, noise controlled environment.

**Materials & Construction**

A rainscreen of larch shingles is proposed for both roof and wall cladding.

A steel and timber frame is designed to resist a seismic event.

Internal walls are to be formed with a timber cassette system and will incorporate storage. This framework of recycled wood, fabric and insulation will be used as an interior partition.

Internal walls are to be formed with a timber cassette system and will incorporate storage. This framework of recycled wood, fabric and insulation will be used as an interior partition.

Internal walls are to be formed with a timber cassette system and will incorporate storage. This framework of recycled wood, fabric and insulation will be used as an interior partition.

Internal walls are to be formed with a timber cassette system and will incorporate storage. This framework of recycled wood, fabric and insulation will be used as an interior partition.

**Solar PV & Solar Thermal Collection**

Solar PV & solar thermal collection panels line the south facing facade, supplying electricity and hot water for heating and domestic use.

**Natural Daylighting**

Natural daylighting will be supplemented with LED light fittings that are powered by photo voltaic panels.

**Modular Forms of Construction**

Modular forms of construction are proposed, allowing the prototype school to be configured in a number of ways to suit local requirements.

Through construction of the school, local labour will learn techniques appropriate for seismically active regions, knowledge that can be used to reduce the seismic hazard in other buildings.

**Concrete**

Concrete serves as a structural bracing element for the roof structure and also contains radiant heating pipes. A seat wall formed from the concrete provides an active edge to the internal street.

**A rainscreen of larch shingles is proposed for both roof and wall cladding.**

**A steel and timber frame is designed to resist a seismic event.**

**Internal walls are to be formed with a timber cassette system and will incorporate storage. This framework of recycled wood, fabric and insulation will be used as an interior partition.**

**Incoming air is preheated in a dedicated space below raked seating in the gymnasium / internal street and is distributed to the main spaces. Well insulated, large ducts reduce energy required to pump the air and reduce heat loss to the building fabric through the duct.**

**Underfloor heating uses low-grade heat to heat up the space from the ground up, ideal for large volume spaces. Pipes are embedded into the floor slab to maximize comfort through the high thermal mass concrete. Voids in structural beams are used as risers for hot water pipework.**

**Solar PV & solar thermal collection panels line the south facing facade, supplying electricity and hot water for heating and domestic use. Natural daylighting will be supplemented with LED light fittings that are powered by photo voltaic panels.**

**Modular forms of construction are proposed, allowing the prototype school to be configured in a number of ways to suit local requirements.**

Through construction of the school, local labour will learn techniques appropriate for seismically active regions, knowledge that can be used to reduce the seismic hazard in other buildings.
COST & AFFORDABILITY

The scheme employs systems such as the steel frame that are well understood locally, and more innovative systems such as the timber cassette system which are low tech responses to the particular challenges of the region. By working with local supply chains and contractors we would seek to establish an affordable building system for walls and roofs based on simple components that are readily available. These systems are commonplace in Europe and can be established in Mongolia with some enterprise and local expertise. A design has been developed that allows for future adaption and future-proofs against operational costs by maximising the use of sustainable technologies including on-site energy generation. Such technologies may be donated to the school through charities and grants - a successful system that has been implemented globally.

IMPACT & COMMUNITY INVOLVEMENT

In the next design stage we would encourage involvement with the local school team, stakeholders and the wider community to gauge their thoughts and incorporate relevant ideas and local knowledge. We would welcome the involvement of the teachers and children in the design of murals and landscape elements. Our aim is that the school is built using local materials and labour wherever possible and we would work with local contractors and craftspeople to create a built manifestation of this partnership. The scheme is designed to be fully accessible with showers and toilets for the disabled and able bodied.

FUTURE EXPANSION

Lean School is based on modules of two classrooms, each providing for 25 pupils combined with a taller ‘centra’ module which serves as a physical education hall, library and simple multipurpose space.

This modular system allows for expansion into many different types of sites and locales including an existing school site, such as this version of Khovd-or a new site altogether.