In the upcoming years a few hunderds of pedestrian bridges in Rotterdam have to be replaced. At Agentschap NL and at Ingenieursbureau Gemeentewerken Rotterdam (IGWR) there is the desire to take sustainability into account when replacing pedestrian's bridges. There was however not much information available yet about the criteria that make a bridge sustainable, and how to incorporate sustainability in the civil design process.

During this graduation project a manual is desgined that gives practical guidelines specifically targeted at the sustainable design of pedestrian's bridges.

Design of Sustainable Bridges

manual for civil engineers

The manual has two goals: To introduce a new design process, in which sustainability is an integrated criterium; and to give visual information on what makes a bridge sustainable.

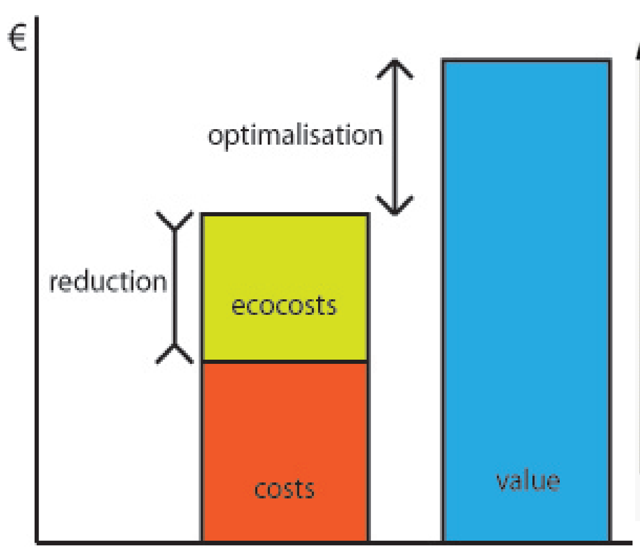
The current design process in civil engineering design in general and at IGWR in particular is analysed and compared with design processes in fields -for example product design- in which sustainability is already integrated. The new design process gives guidelines on how to take into account the extra requirement of sustainability with respect to the habits, way of working and way of thinking of the civil engineer.

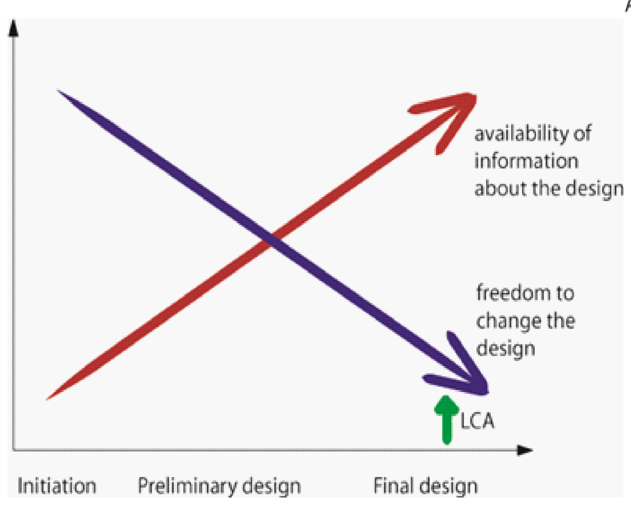
The civil engineer is introduced to the concept of sustainability, for which a practical definition is given. In this definition the value of the bridge should exceed the costs and the ecocosts of the bridge. Other terms the civil engineer is introduced to are:

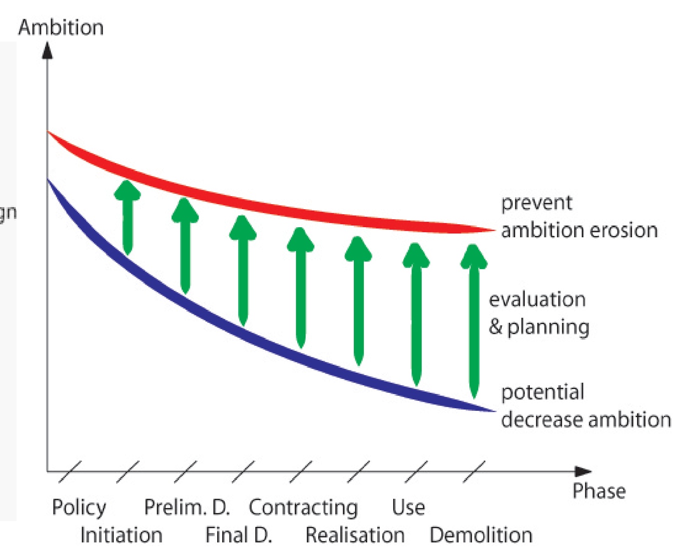
ecocosts according to the EVR method (www.ecocostsvalue.com),

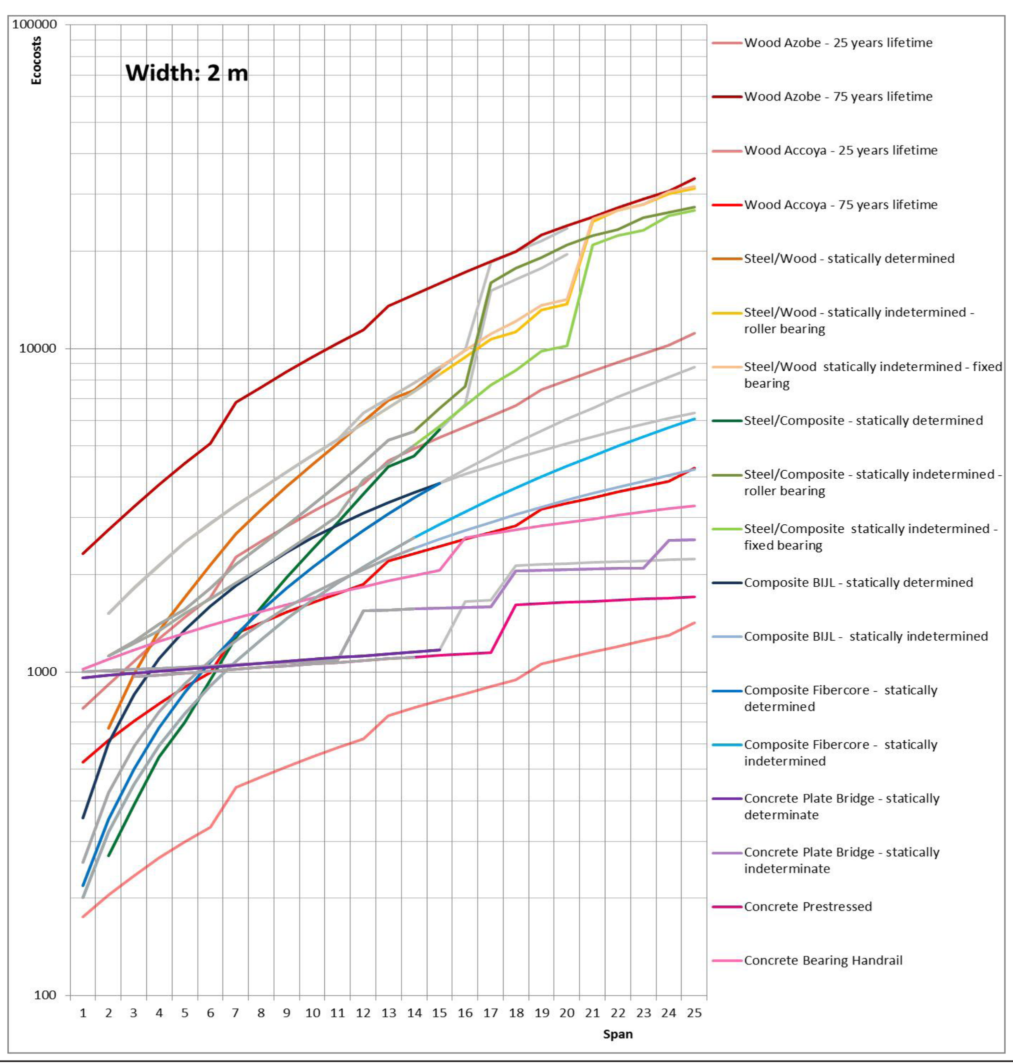
the LCA dillemma (in the beginning of the design process, there is not much information available of the design; LCA calculations are therefore traditionally done at the end of the process, but at that point making changes in the design is difficult and costly; LCA calculations should evolve from the beginning of the design process),

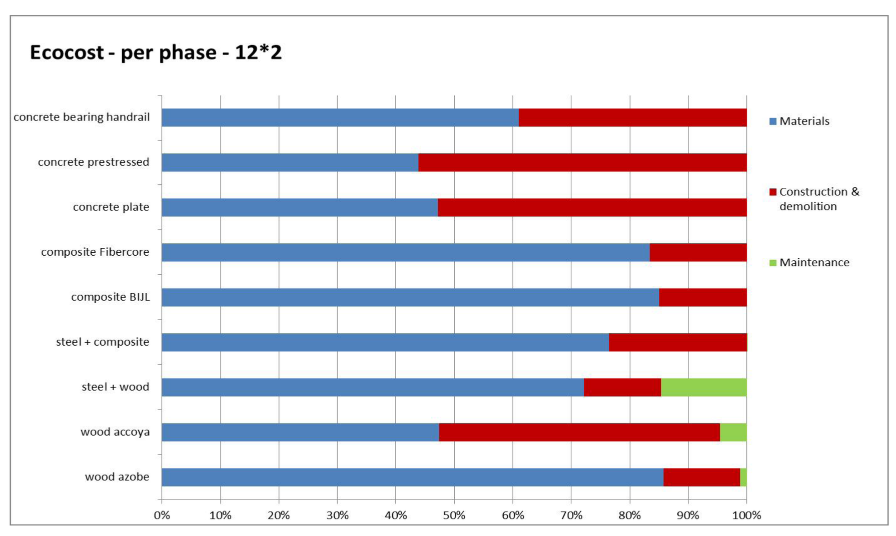
the sustainability ambition erosion (without constant evaluation and planning, the ambition in the beginning of the process to make a sustainable product reduces drastically).

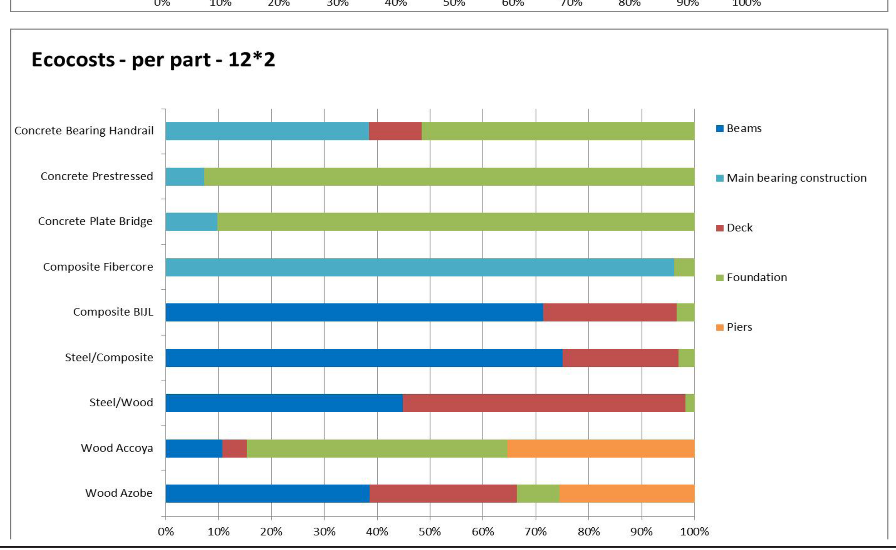












The ecocosts of different standard bridges of different materials (materializations) are compared for spans up to 25 meters and widths of 0,5 to 5 meters are compared. It is also researched what causes these ecocosts: which part of the bridge (beams, deck, foundation and piers) and which phase in the lifetime of the bridge (materials, construction and maitenance). Examples of the results are in the graphs on the left.

There is not one type of bridge which is the most sustainable. Some materialzations for example achieve best on smaller spans or widths, others for bigger bridges. Which bridge is the best choice for a bridge of a certain span and width can be found in the manual in the given graphs.

For some types of bridges the material of the bridge itself (the beams and deck) are the biggest contributers to the ecocosts (this is for example true for composite); for other materializations the foundation has a far bigger influence (especially composite bridges). Also the influence of construction ont he total ecocosts differs for the different materializations. If the goal is to design a more sustainable bridge of a certain type, the strategy to do so depends strongly on the materialization. For some materials (steel and composite) the lifetime of the bridge can be prolonged by for example standardized and modular building. Other types of bridges (concrete) should especially be used in specific situations (solid soils). Sometimes (wood) a different -more sustainable- material can be considered (accoya wood).

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