Designing as research has received increased attention in landscape architecture. Recently, Lenzholzer et al. (2013) offered definitions for designing activities that can be research. Generally speaking, all design activities that generate new knowledge can be ‘research through designing’ (RTD). Different types of RTD can be identified, based on Creswell’s widely accepted framework of research methods (2009). To clarify what these approaches can mean for RTD in landscape architecture research methods, they need to be explained through examples. In this paper, we discuss examples for the (post)positivistic type of RTD. This type of RTD is based on the positivistic methods of natural sciences. The new design knowledge to be generated is mainly ‘objective’ and quantitative and can answer research questions that mostly deal with physical issues, such as climate change, as our examples show.

INTRODUCTION
Within landscape architecture new approaches on research and design were recently discussed. First ideas about designing as being a kind of research were posed within architecture (e.g. Jong and van der Voordt 2002). After long denial about such connections between design and research within landscape architecture, Deming and Swaffield (2011) indicated that landscape architectural designing might indeed be research. Nijhuis and Bobbink (2012) not much later stated more assertively that designing can be research, but had not proven how it fits into general ideas about research methods. Lenzholzer et al. (2013) filled that gap and suggested, that the process of employing designing in a research process is valid academic research when it is based on Creswell’s (2009) different types of ‘knowledge claims’ and related research methods. Creswell discussed three substantially different kinds of research: (post) positivist, constructivist and participatory research. All three types can be combined into ‘pragmatist’ research. In line with Creswell, Lenzholzer et al. (2013) discussed four different types of ‘research through designing’ (RTD) for landscape architecture and pointed out that examples of RTD need to be elucidated. We want to continue from that point in the discussion of RTD and sketch examples. In this paper, we give examples of (post)positivist RTD.

Given the fact that climate change and designing for climate is a new challenge for landscape architects, we will discuss a range of projects that respond to climate. The RTD methods that fit the (mainly) physical processes of climate belong to (post) positivist research because climate processes are known to be complex and very dynamic and need thorough quantitative analysis. We discuss three RTD examples according to the parameters sketched by Lenzholzer et al (2013) for (post) positivist research. These parameters concern the kind of new design knowledge that is produced (e.g. predictive, ‘objective’, deductive/ generalizable, quantitative, verified theory/ design guidelines, patterns, prototypes), the issues that research
questions address (e.g. physical/functional and sometimes psychological), the RTD methods (e.g. design hypothesis testing, design experiments tested with surveys, simulations or measurements, systematic and strict procedure) and the evaluation criteria used (e.g. ‘objectivity’, validity, reliability, generalizability).

1. ROOFTOP PLAZAS THAT EXTEND THE SEASON OF OUTDOOR USE

This project investigated alternative designs for a rooftop plaza in Manhattan, and other similar projects. The climate conditions on the top of a tall building can be extreme due to increased wind speed and a lack of shade. To identify design guidelines that would lead to thermally comfortable conditions throughout the year we tested a wide range of design options with the human thermal comfort model COMFA. Through RTD the optimum configuration of shade and windbreaks was determined.

The new knowledge is objective and quantitative but depends on the physical characteristics of the site. The general design guidelines and the method are applicable universally. The issues that were addressed in this project were physical and functional. The physical issues concerned outdoor thermal comfort during all seasons of the year on top of a tall building.

The functional issues related to extending the season of use so that people could use the urban plaza for a longer period of time each year.

The area surrounding the New York Times Tower in Manhattan was modelled on the computer to identify solar and terrestrial radiation patterns (fig.1). A solar simulation identified the number of hours per day that each part of the rooftop would be in sun or shade on representative dates such as the summer solstice (fig.2). A scale model of the building was tested in a wind tunnel. Various wind screen options were evaluated until the optimal design was identified. Then the wind and radiation data were combined with typical weather conditions in each season, and input to COMFA. The model was used to test the effectiveness of design options on the thermal comfort of people in various seasons. The example included here was the simulation of a sitting area. With no shade a person would be too hot for much of the day (fig. 3) but under the shade of birch trees a person would be thermally comfortable through most of the day and also receive protection from wind (fig. 4). The study was able to identify design guidelines for use on rooftops in Manhattan and. Similar RTD studies in other climates could generate regionally-specific design guidelines.
2. STUDY ON THERMALLY COMFORTABLE DUTCH SQUARES

This project aimed at generating design guidelines for climate responsive design of Dutch town squares. The research mainly addressed the problems of wind and heat that visitors of squares can often be exposed to.

The new knowledge created mainly consisted of spatial, quantifiable design guidelines or ’prototypes’ for interventions that improve thermal comfort on Dutch squares of average size. These ’prototypes’ or patterns were also usable in other cities of similar latitude and climate regions.

The issues addressed were of physical and functional kind. The physical issues concerned outdoor thermal comfort. Functional issues concerned the types and configuration of spatial interventions. Since urban squares are usually also used for markets, events, fun fairs, etc. the choice of suitable climate improving elements was limited.

In the research process, different types of climate improving elements were assessed on their relation with functional issues and many elements were excluded from further consideration (e.g. fig. 5). The remaining possibilities were tested on thermal sensation of people on the squares. These tests were done for two ’case-squares’ with the microclimate simulation software ENVI-met®. First the existing situations were simulated for a hot day on the longest day in summer and a typical windy late autumn day. The set of climate elements, that passed the ’functionality study’ was then simulated for its physical effects on thermal comfort. Evaluations showed that the set of elements needed improvement and other patterns were developed and tested. Eventually, the use of a shelterbelt (fig. 6) that protects from wind and also casts sufficient shadow appeared the most optimal solution (fig. 7). Therefore, this ’prototype’ can be recommended as a generalizable design guideline to improve thermal comfort on mid-sized squares in temperate climatic conditions. However, such a rigid pattern might sometimes be difficult to implement in all places and requires fitting to the locality.

3. ’COOL’ DISTRIBUTION OF TREES IN STREET PROFILES

The goal of this project was to generate optimal planting patterns for street trees in North Western Europe to combat urban heat islands and improve indoor temperatures in adjacent houses. Such patterns were developed for typical residential streets (height/width ratio ½; average street width 12 m) for different orientations. The study aimed at two sorts of knowledge generation- first of all to develop concrete design guidelines for street tree placement in the typical street profiles that consist of quantitative and spatial information. Apart from that, the study also generated a simple testing method that can be used for climate responsive design of other types of streets.

The major focus was on physical thermal issues: where and when the largest heat problems occur in the streets and which spatial patterns of trees of different sizes and distributions are apt to combat heat problems without affecting solar access in adjacent houses.

To simulate the ’hotspots’ in the streets, SketchUp was used to depict the shadow patterns of the streets without trees. The simulations were made for several points in time per summer day and overlaid in Photoshop to visualize the areas that receive most and least shading. Subsequently, trees of various distributions and sizes were projected into the streets and the same
simulation were run in SketchUp and combined in Photoshop. The simulation outcomes were evaluated on the duration of shading and solar access to adjacent houses. This yielded a range of street tree patterns that provide optimal shading without hampering solar access to houses. An overview of the outcomes is given in fig. 8 where the most optimal patterns are marked. However, their applicability still needs further assessment in relation to traffic infrastructure, underground cables, pipes and ducts that differ per location. So, these kinds of ‘ideal patterns’ require adjustment to a real site.

4. CONCLUSIONS

We discussed three examples of climate responsive RTD and showed how they are embedded in the (post)positivist research methods and their typical parameters. In all cases the knowledge to be generated consisted of quantitative and spatial design guidelines or prototypes. The research issues to be touched upon were physical, but often functional issues also played a role. The RTD methods used in our examples consisted of design hypothesis testing, mostly with computer simulations. The research methods used in our examples consisted of design hypothesis testing, mostly with computer simulations. The results were evaluated on a quantitative and spatial basis. Although generalizability of such new knowledge (prototypes, design guidelines, etc.) is often an aim of (post)positivist RTD research, we noticed that this knowledge is not always generalizable and often needs adjustment to site specifics. Our – and many other examples that we cannot discuss here - show that designing for and with climate is complex, with dynamics in time and space. The rigidity of (post) positivist research can help do deal with these complexities and we thus recommend to use such (post) positivist RTD methods when landscape architects have to address climate in their design and research projects.

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REFERENCES