GOING WITH THE FLOW

Crowd simulation is helping safety and operations in stadiums today and its usefulness is increasing with the addition of 3D visualisation, integration with BIM and the exploitation of big data.

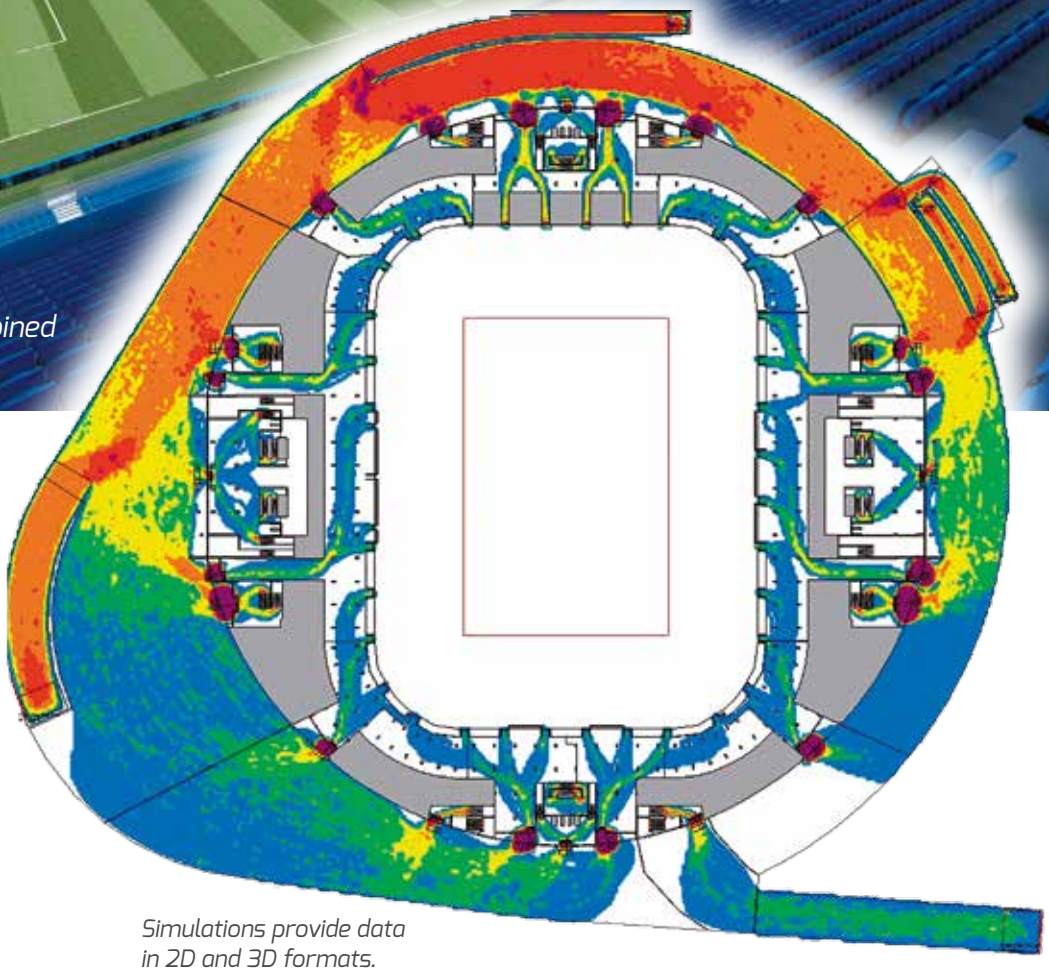
Building data can be combined into crowd simulations.

Crowd simulation software was originally intended to help architects and stadium and event managers ensure safe access for pedestrian spectators to and from the venue or during an emergency evacuation. However, over time the use of simulations has evolved to consider use of space to deliver commercial and financial benefits, advises consultant Simon Ancliffe from Movement Strategies.

Commercial benefits can be derived by accurately determining the space required for efficient but safe spectator flow, thereby reducing build costs or freeing up space for other uses – whether it be additional retail or visitor facilities, or property development in the wider masterplan so frequently seen around stadium development these days.

NEW GENERATION ON HORIZON

Ancliffe believes that after a period when crowd simulation technology has remained fairly static, the next few years should see change in the available simulation technologies that will increase its benefits and take-up.



Simulations provide data in 2D and 3D formats.

3D visualisation is becoming easier and should advance further with integration of pedestrian simulation tools with building information management (BIM) systems. Better visualisation means that a multi-stakeholder and non-expert group can work through their assumptions and see outcomes. For example, this will help develop a 'concept of operation' during the design phase of the building, calling on the expertise of operations staff such as stadium and arena managers. ***"This dialogue is really important,"*** says Ancliffe. ***"You can see a design in CAD but simulation has real value for both design and operations."*** »

Another change will arise from the use of the increase in the available data on pedestrian and crowd movement that will become available.

Ancliffe observes that today's design standards still rely on crowd movement data on pedestrian movement much of which was collected in the USA in the 1960s. There is now an opportunity to collect more bespoke data, from intelligent CCTV applications, thermal cameras, and wi-fi and smartphone tracking. Better data will result in more bespoke modelling, calibrated for particular environments.

Another challenge will be to simulate in the future what we can't at the moment - for example, high density crowds at the front of stage during concerts.

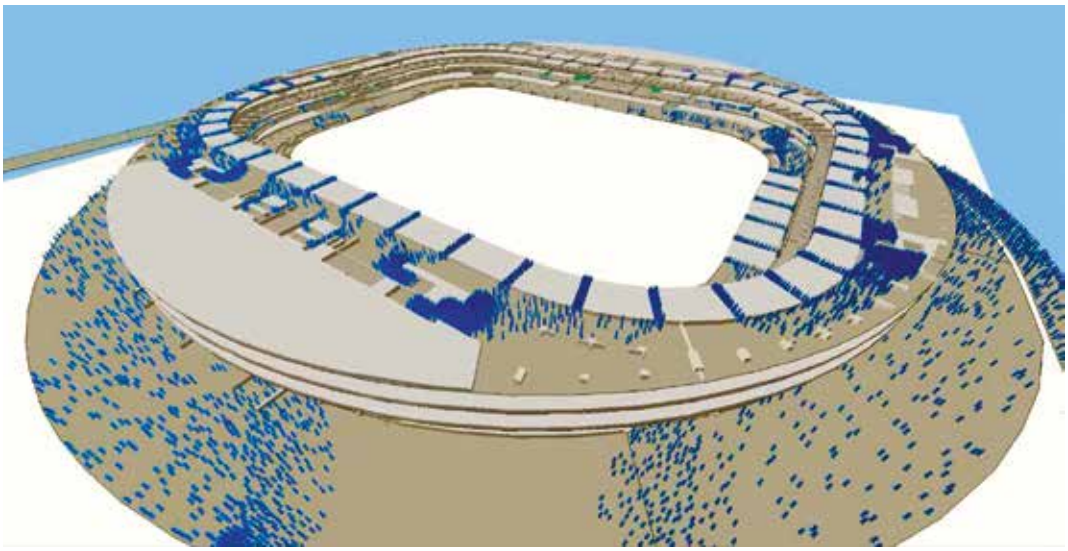
SECURITY AND EMERGENCY SIMULATION

How does the National Center for Spectator Sports Safety and Security (NCS4) view this technology? Lou Marciani, Director, NCS4, says: ***"Crowd simulation software, when properly applied and deployed, can work throughout the entire venue enterprise life-cycle phases: from design-build-reconstruction validation to day-to-day emergency preparedness and operational optimisation of people, process and infrastructure."***

Located at the University of Southern Mississippi, NCS4 supports the advancement of sport safety and security through training, professional development, academic, programmes and research. NCS4 collaborates with professional leagues, open access events (Marathons), intercollegiate and interscholastic athletics, along with professional associations, private sector firms, and government agencies. ***"We are a critical resource for sport venue managers, event managers, first responders and other key stakeholders,"*** says Marciani.

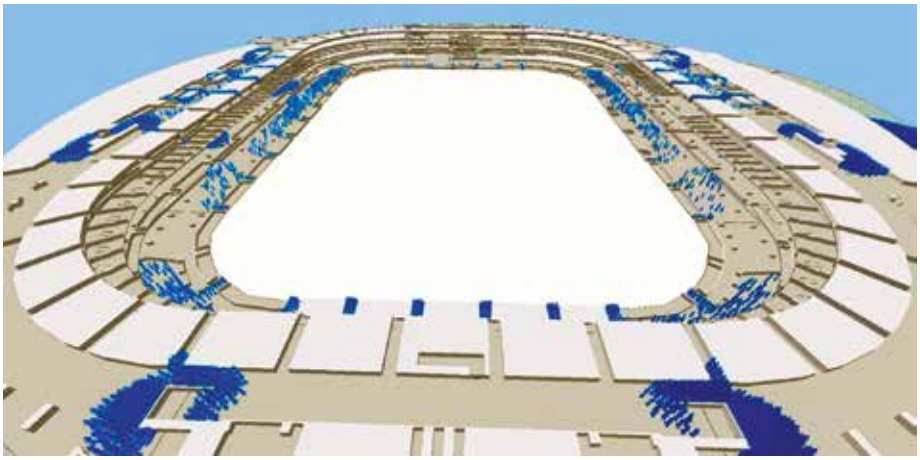
Stadium developers can use crowd flow simulation to optimise fan experience as well as safety.

NCS4 uses SportEvac simulation software for academic research and best practices. It has also partnered with INCONTROL to offer SportEvac Training, Operation and Planning software for venue staff. SportEvac provides those responsible for venue and event security, a software system to aid in their 'what-if' scenario management, daily operations and staff training. ***"It is an all-embracing software that enhances the users' situational knowledge to optimise their decision making capabilities of preparedness, response and***



Evacuation simulation.

Lou Marciani, NCS4.



3D renderings help stakeholders visualise outcomes of design decisions.

assessment," explains Marciani. ***"When using SportEvac, users will be better prepared to mitigate, respond and recover from both natural or man-made crises and daily affairs."***

Crowd simulation software provides an effective method to simulate 'what-if' scenarios of natural or man-made incidents and emergencies in realistic 3D graphical 'avatar' environment to properly visualise, train, prepare, communicate and respond to ensure safety of the venue and fans.

"Key to the success is to develop and implement a resilient training programme and culture around the software and adopt best practices into the daily standard operating procedures," says Marciani.

SOCCER SIMS

Ben Veenbrink, Managing Director of The Stadium Consultancy (TSC) and member of the UEFA expert panel on stadium construction and management, has used simulation to deliver venues for major soccer tournaments, most recently Euro 2012 in Poland and Ukraine. ***"Crowd simulation software is useful during major events to simulate the impact of the event overlay on the access, egress and evacuation of the stadium and precinct,"*** explains Veenbrink. ***"Furthermore the (existing) contingency and emergency plans of the stadium can be tested and verified."***

As part of its consultancy services for the planning, development, operation and management of stadiums, TSC develops safety management plans for stadiums. During Euro 2012 TSC faced several challenges related to the delivery of the venues. As the majority of the venues were brand new with new operators on board, crowd simulation helped the operators and UEFA to familiarise themselves with the venues and the critical areas of the crowd circulation. It helped to raise awareness

Frank Wijnveld, Crowd Professionals.

with regard to bottlenecks, especially in some of the venues where the external space was limited, and to prioritise the safety aspects of certain proposed design solutions and overlay plans with all stakeholders. ***"In some venues it really helped to improve overall safety of all spectators by implementing additional physical and/or operational measures after identification of critical areas as a result of the simulation,"*** says Veenbrink.

Veenbrink advises that crowd simulation is also useful as a day to day tool for the safety management in a venue. Various contingency and emergency plans can be simulated and verified. For example, what to do during an evacuation when one of the routes is not available. Also changes and modifications to the building can be simulated, for example the impact of relocating a concession.

CROWD PROFESSIONALS

Frank Wijnveld from Crowd Professionals, based in Utrecht, the Netherlands, points out that FIFA, UEFA and the national FAs, through their regulations, demand many guarantees and provisions of stadiums and clubs in the area of safety and security, especially within the area of the so-called 'safe capacity'.

INSIGHT INTO CROWD FLOWS

Guaranteeing crowd safety, security and comfort in today's and future stadiums is imperative. Complying with stadium guidelines, driven by authorities, is a complex task for both stadium designers and operators. Crucial for this task is to gain insight into crowd flows throughout the whole venue lifecycle. **INCONTROL's** crowd simulation software Pedestrian Dynamics offers this opportunity. Pedestrian Dynamics is used worldwide by architects, engineers, construction companies and consultants to validate stadium designs. Ranging from High School Sports Venues to World Cup Soccer Stadiums.

INCONTROL observes an increasing use of crowd simulation software in daily operation. Venue owners benefit from integrated systems with simulation capabilities by creating higher safety, comfort and experience for their visitors.

"Our real time crowd analytics, forecasting capabilities and 3D visualisations raises the preparedness and situational awareness of venue operators and increases commercial performance. Leading system integrators and technology providers team up with us to integrate our crowd simulation technology into their Smart Stadium Solutions" says INCONTROL's Jeroen Steenbakkers, Division Manager Crowd Simulation Solutions EMEA.

REALISTIC AND PRACTICAL

Movement Strategies is a leader in using 2D/3D simulation to help design and manage complex crowd environments, such as the London 2012 Olympic Park and major stadium projects, such as that for Tottenham Hotspur FC.

Given the implications of the simulation results for real-life (e.g., safety, build cost, user experience and operations) we strongly advocate that the simulations are developed by experienced consultants using reliable data inputs or transparent assumptions, and then that the results are scenario tested and risk assessed.

We find our advice benefits from our experience observing crowds at major venues and events and our knowledge of human behaviour in different environments and cultures. Our role in event control rooms also affords us insight into the management of crowds. We use this real-world experience to ensure that our simulations are realistic, and the subsequent recommendations are effective and practical.

Additionally, our leading crowd movement measurement capability provides us with robust data that we include in our simulations. Ultimately, this leads to evidence-based design, and supports real-time decision-making on event day.

Significant interventions in London 2012 resulting from our simulations included VIP movements, the design and operation of the Aquatic Centre, the common circulation areas and security screening areas.

"From the perspective of stadium ownership and management, the focus on liability following on all stadium operations is even more important," says Wijnveld. ***"If visitors feel comfortable and safe, they will be inclined to stay a little longer, to make more use of facilities and amenities and they will be more willing to visit the stadium again in the near future."***

After a career at the Dutch police, Wijnveld was the security and operations manager of PSV Eindhoven and afterwards the director of the Philips Stadium. He thinks that crowd simulation is very useful for managing a football stadium, enabling the responsible management to fulfil their obligation in this regard. The simulation tool analyses all crowd flows that runs in- and around the stadium, combines it with all useful building data and offers a unique insight and more understanding in all possibilities and limitations regarding evacuation, safety and (commercial) operations. The tool also allows the stadium management to create a preview of the possible effects of redecoration or reconstruction plans.

Wijnveld advises: "***Crowd simulation software is both suitable for strategic planning and day-to-day operations. During the design phase of stadiums and arenas a lot of important strategic, operational and commercial issues have to be considered.***

"***In every phase of design and planning the simulation tool can be used to analyse the practical feasibility of plans. How much time do we need to evacuate the stadium? How many emergency exits, toilets, lockers and staff do I need? What positions for catering are most suitable to maximise commercial revenues? By modelling and analysing all crowd flows and evacuation scenarios during the design phase it is possible to answer on strategic issues regarding:***

- ***The (financial) feasibility of construction plans in relation to all FIFA, UEFA and local demands and regulations regarding safety and security.***
- ***The feasibility of the intended capacity.***
- ***All possible evacuation scenarios, including elements such as optimal crowd flows, bottlenecks and (safety) risks, different alternative (emergency) scenarios, partial evacuations and ingress and egress of visitors, also in relation to the immediate vicinity.***
- ***Safety plans and the number of security staff needed.***
- ***The commercial attractiveness of a location.***

Simulation is not just for the designers however. ***"The simulation tool above all offers a unique insight in the day-to-day operation, helps to evaluate and validate operational processes and to forecast the possible effects of adjustments for licensing authorities, stadium management and other stakeholders,"*** explains Wijnveld. ***"For instance: at the Philips Stadium, home of PSV Eindhoven, the simulation tool analysis led to a tactical adjustments of contingency plans of the main building, resulting in a shortening of evacuation by, at least, three minutes; a massive improvement! The security officer frequently carries out different simulation scenarios to improve various processes and to train security staff accordingly."***

Wijnveld likes that the outcome of analysis comes both as Excel output in 2D and as 3D video visualisation. ***"In every simulation project we noticed that this visualisation helps all stakeholders to create a better idea of upcoming events or building adjustments; for instance when the stadium is to be used as a concert venue. At the same time the stadium management can use the tool to identify revenue opportunities in these new plans through an ameliorated accessibility."***

The simulation tool has further capabilities:

- **Support the training of security staff.**
- **Increase the understanding of emergency routes and the difficulties of the stadium vicinity among all relevant services and officials (police, fire brigade, medical services).**
- **Enrich the stakeholders decision-making processes on various subjects; for instance redecoration plans.**
- **Recurrently evaluate the efficiency of operational processes**
- **Identify the commercial attractiveness of commercial spots by analysing the outcome of crowd flow measurements.**

If the stadium is already in operation, new and existing conditions will regularly have to be reconsidered because every event or activity in the stadium has its own organisation, set-up and therefore guidelines for safety and capacity. A football match has different needs than a concert. At all times, venues want visitors to feel welcome, safe and satisfied.

"CrowdProfessionals' generic aim is to improve safety and security within sport (especially football) and events, but at the same time we look into business concepts of (multipurpose) stadiums, arenas and other locations where large crowds assemble," explains Wijnveld. ***"We therefore highly value our collaboration with INCONTROL since it results in an exclusive high quality partnership that combines scientific analysis with operational efficiency that all comes together for our clients. Our method rapidly raises the bar for all stadium and safety operations and fulfils all demands of liability."*** ■