Guadalajara

CIUDAD CREATIVA DIGITAL

CARLORATTIASSOCIATI SRL with DENNIS FRENCHMAN

ACCENTURE + ARUP + ENGRAM STUDIO + FUNDACION METROPOLI + MOBILITY IN CHAIN
MIT SENSEABLE CITY LAB + STUDIO FM MILANO

Guadalajara

CIUDAD CREATIVA DIGITAL

Plan Maestro de Guadalajara - Ciudad Creativa Digital
Noviembre 2012

CIUDAD CREATIVA DIGITAL

Un proyecto para:
Guadalajara CCD A.C.

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MIC
mobility in chain

senseable city lab

STUDIO FM MILANO SRL

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2009 2010 2011 2012 2013 2015 2019 2023

May June July August September October November December January February March April May June July August September October November December January February March April May June July August September October November December January February March April May June July August September October November December January February March

From concept to masterplan

- Initial concept design for **CCD** — Mexico City
- Initial research of **creative places** — Mexico City
- First research trip to US media companies — California
- Research trip to European media companies — UK/France
- Development of conceptual vision of CCD smart city — Mexico City
- Research into **smart cities** — Mexico City
- **Initial contact with MIT** for expert validation on concept — Boston
- Research trip to smart city projects — Shanghai/Seoul DMC/Songdo/Singapore
- Development of Strategic Guidelines by MIT-CRA — Boston/Turin
- Workshop at MIT on Strategic Guidelines — Boston
- Submission of **Strategic Guidelines Report** — Mexico City
- Conceptualization of Smart City Telecom Infrastructure — Mexico City/Guadalajara
- Initial plans for Telecom infrastructure - Guadalajara
- **Masterplan design awarded to CRA Consortium** — Boston/London/New York/Turin/Milan/Madrid/Mexico City
- Masterplan "kick off" workshop — Guadalajara
- Masterplan workshop — Guadalajara
- Masterplan workshop — Barcelona
- **Submission of Masterplan Design** — Guadalajara

Site selection to land development

- Scoring analysis of candidate cities — Mexico City
- Initial site scouting — Guadalajara/Tijuana/Puebla/Monterrey
- **Four finalist cities notified** — Guadalajara/Tijuana/Puebla/Monterrey
- **Site assessment trip** — Guadalajara/Tijuana/Puebla/Monterrey
- MIT-CRA work on site selection analysis
- **Site selected** and notified — Guadalajara
- Initial land acquisition — Guadalajara
- **Phase 1: mobilize development of catalyst projects**
- **Phase 2: expand to critical mass**
- **Phase 3: complete build of CCD polygon**

Project governance and investment

- **ProMexico joined DUIS** group — Mexico City
- Design of **ProaAV Fund** - Mexico City
- Initial project discussion with **Secretería de Economía** (SE) — Mexico City
- Implementation of ProAV Fund
- **Directive Board established** for project headed by Lorenza Martínez (SE) — Mexico City
- DUIS prevalidation process — Guadalajara/Tijuana/Puebla/Monterrey
- Development of **Phase 1 Business Plan and Governance Model** — Guadalajara/Mexico City/London
- ProMexico Joined MIT Senseable City Lab Consortium — Boston
- Formalization of **Guadalajara CCD A.C.** headed by Octavio Pargar (CANIETI)
- IBM confirm participation in project — Guadalajara
- **Inauguration of newly elected mayor of Guadalajara** Ramiro Hernandez Garcia
- DUIS approved — Guadalajara
- **Inauguration of newly elected President of Mexico** Enrique Peña Nieto
- **Inauguration of newly elected Governor of Jalisco** Aristoteles Sandoval Diaz

Socialization and promotion of CCD

- Development of initial CCD branding — Mexico City
- Preparation of promotional material for World Economic Forum — Boston/Turin/Milan/Mexico City
- CCD presented at **World Economic Forum** — Davos
- **Public unveilment** of CCD project — Guadalajara
- **Socialization process** with public initiated — Guadalajara
- Initial roadshow - London
- European Roadshow — UK/France/Germany
- West Coast Roadshow — San Diego/LA/San Francisco/Vancouver/Seattle
- East Coast Roadshow — NY/Montreal/Toronto
- Foro Ciudad 3 — Guadalajara
- Foros "Cauce de Participacion Institucional" — Guadalajara

EL EQUIPO

carlorattiassociati srl
Walter Nicolino & Carlo Ratti

carlorattiassociati | Walter Nicolino & Carlo Ratti es un estudio de arquitectura en rápido crecimiento establecido durante el verano de 2002 en Turín, Italia. Basado en el estudio de Carlo Ratti en el Massachussetts Institue of Technology, la oficina se encuentra actualmente involucrada en el desarrollo de proyectos en Europa, America y Asia. El trabajo de la oficina de arquitectura se enfoca en revolucionar el como utilizamos la informática urbana en el ámbito de la arquitectura, trabajando todas y cada escala hacia un futuro social, económica y ambientalmente sustentable. Entre sus proyectos mas recientes se encuentran el diseño de la sede de la casa de moda líder Trussardi en el centro de Milán, Italia, las viviendas Tsunami-Safe[r] en Sri Lanka, The Cloud para los Juegos Olimpicos de Londres 2012 y el Pabellón de Agua Digital de la Expo en Zaragoza, España. El estudio se encuentra actualmente involucrado en el diseño de nuevas ciudades tanto en la Región del Golfo como en Centroamérica. El estudio ha sido seleccionado en repetidas ocasiones como una de las oficinas de mayor nivel y prestigio en Italia por la Bienal de Venecia en 2004, 2006 y 2010, a si mismo a recibido numerosos galardones internacionales, incluyendo 'Best Invention of the Year´ por parte de Time Magazine y su trabajo ha sido destacado en reconocidas publicaciones internacionales incluyendo el New York Times, el Boston Globe, Der Spiegel, Discovery Channel, BBC, Domus y Abitare.

Team
Carlo Ratti / Walter Nicolino / Jenni Young / Andrea Galanti / Giovanni de Niederhausern / Alberto Bottero / Andrea Cassi / Pietro Leoni / Antonio Atripaldi / Rene Perez Ignacio / Sofia Cornejo / Luis Mesejo

junto a:

Prof. Dennis Frenchman

Con motivos de este proyecto, participara junto a CRA, el Profesor Dennis Frenchman de MIT, quien jugó un papel central en la selección del Parque Morelos como área del proyecto, en el desarrollo de las líneas de actuación estratégica y en el diseño urbano de CCD. El profesor Frenchman se encuentra entre las autoridades lideres del mundo con respecto al diseño y desarrollo de ciudades creativas y de medios digitales, así como en el sector digital publico. Entre su experiencia cabe destacar el diseño de Seoul Media City en Korea, Milán Digital en Zaragoza, España, Media City: UK en Manchester y Twofour54 Media Zone en Abu Dahbi. Es director del Centro de Urbanismo Avanzado de MIT e investigador co-principal en Making Clean Energy Cities en China, un estudio de suma importancia para la Energy Foundation.

accenture
www.accenture.com

Accenture es una firma global en manejo en consultaría, tecnología de servicios y externalizacion de compañías con mas de 257,000 personas sirviendo a cliente en mas de 120 países. Combinando una inigualable experiencia, capacidades integrales que comprenden todas las industrias y funciones de negocio, asi como una extensiva investigación acerca de las compañías mas exitosas del mundo; Accenture colabora con sus clientes para ayudarlos a convertirse en negocios y gobiernos de alto rendimiento. Accenture es una compañía Fortune 500 enlistada en la bolsa de valores de Nueva York. La compañía generó ingresos por $27.9 billones de dólares durante el año fiscal finalizado el 31 de Agosto de 2012. La oficina de Ciudades Globales Inteligentes de Accenture esta comprendida por profesionales expertos dedicados al programa de desarrollo urbano. Cuentan con proyectos tanto concluidos como en desarrollo en America Latina, Asia, Europa y el Medio Oriente. El trabajo con respecto a Ciudades Inteligentes es cliente-independiente y se impulsa por su valor. Trabajan con ciudades para identificar sus retos y oportunidades para así desarrollar soluciones arquitectónica y programáticamente relevantes. Su enfoque esta en ayudar a las ciudades a alcanzar su valor estratégico de TIC resolviendo sus retos urbanos y trabajando a la punta del diseño físico y digital, no solo con un enfoque de soluciones tecnológicas, también con componentes 'suaves' como modelos de negocio, modelos de gobernanza, y estrategias de innovación financiera que fomenten la creación de un valor socio-económico y ambiental a largo plazo. Accenture cuenta con oficinas y operaciones en mas de 200 ciudades en 54 países. Con motivos de este proyecto han formado un equipo involucrando expertos con experiencia en mercados locales, su centro internacional de excelencia en Ciudades Inteligentes con base en Londres, así como expertos en tecnologías provenientes de EU.

Team
Ignacio Chacon / Carlos Niezen / Simon Giles / Serge Younes / Jen Hawes-Hewitt / Thomas Rodriguez / Guy Hudson / Lauren Ing / Katie Goodman / Javier Peñuñuri Ramirez / Miguel Bazan Romero /Marilu Peña / Silvio Pla Sarubi / Jessica Ryde

Arup
www.arup.com

Arup es una firma global de diseñadores, ingenieros, planeadores y consultores de negocio que proporciona una diversa gama de servicios profesionales a clientes alrededor del mundo. Arup cuenta con un personal que supera los 10,000 trabajadores, ubicados en 92 oficinas en 37 países; trabajando de forma paralela en mas de 10,000 proyectos en el campo del diseño y la construcción. Arup es reconocido por sus expertos especializados en múltiples disciplinas que comprenden todos los aspectos del medio físico construido, proporcionando así, un alcance interdisciplinario que provee una completa gama de habilidades técnica y de conocimiento. Desde su concepción en 1946, ha sido la fuerza creativa detrás de la mayoría de los diseños mas innovativos y sustentables del mundo. Arup se enfoca en la practica de tres principales áreas a nivel global: edificación, infraestructura y consultaría. Aunado al hecho de contar con un acercamiento interdisciplinario que significa que cada proyecto puede involucrar gente de todos o cada uno de los sectores en los cuales opera, su objetivo fundamental es el de reunir al mejor equipo profesional en el mundo para responder a las necesidades de sus clientes. Con motivos de este proyecto Arup ha conformado un equipo de expertos en sustentabilidad, infraestructura urbana e informática urbana. El equipo esta integrado por personal en nuestras oficina de Madrid, Londres y Nueva York.

Team
Pablo Lazo / Chris Lyth / Lean Doody / Ramon Rodriguez / Francisco Aguirre / Vincent Lee / Alex Mitchell / Jose Garcia

Fundación Metrópoli
www.fmetropoli.org

Fundación Metrópoli es una organización internacional a la vanguardia en la generación de nuevas instituciones de capital intelectual cuya aspiración es contribuir a la innovación y el desarrollo de ciudades y regiones a través de la investigación, intercambio e implementación de conocimiento con el objetivo de construir un futuro sustentable. El objetivo de la Fundación es fungir como catalizadora de transformaciones positivas en las ciudades y paisajes del siglo 21. Con base en Madrid (España) desde 1997, Fundación Metrópoli tiene sus orígenes en la primera 'City Science Center' fundada por la Universidad de Pensilvania, EU. No existe institución individual capaz de responder a la complejidad de un mundo globalizado, por tal motivo una característica clave de Fundación Metrópoli es su trabajo en colaboración con redes de excelencia internacional. Por lo que busca asociarse con un amplia gama de profesionales provenientes de diferentes lugares y bagajes educativos para así generar conocimiento hacia una nueva cultura espacial. Su filosofía enfocada a la acción, guía el entendimiento que se tiene sobre las dinámicas de la ciudad, su conexión con el entorno y su papel en las futuras actividades de una sociedad del siglo 21. Su objetivo fundamental es el de concebir una mejor calidad de vida fomentada a su vez por la participación de aquellos que viven, trabajan, juegan y aprenden en las ciudades.

Team
Alfonso Vegara / Guillermo Sánchez / Ángel de Diego / Mark Dwyer / Lorena Sicilia / Andrea Imaz / María Diez / Aaron Kelley

Engram srl
www.engram.it

Engram es una oficina de visualización digital con base en Italia con mas de 15 años de experiencia, cuya especialización se basa en la visualización arquitectónica. Gracias a su bagaje arquitectónico, su trabajo toma una forma precisa, teniendo por objetivo la comunicación emocional material generada desde la arquitectura misma. Calidad, responsabilidad, habilidades orientadas a la resoluciones de problema y capacidades técnicas, hacen de Engram Studio la opción que una amplia gama de arquitectos alrededor del mundo eligen.

Team
Paolo Zambrini / Riccardo Zema / Thomas Arici / Francesco Spendio / Samuele Ballardini

Mobility In Chain
www.michain.com

MIC | Mobility in Chain con base en Milan, nace de la creencia de que la movilidad tiene una fuerte influencia en la forma en que vivimos y nuestra calidad de vida. Así mismo, MIC se creo a partir de la ambición de mejorar la calidad de vida a través de un profundo entendimiento de como nos movemos. En línea con su previa experiencia profesional, el equipo de MIC se enfoca en proveer consultaría en transporte a desarrolladores, planes maestros y entidades publicas en general alrededor del mundo. MIC adopta una visión innovativa y sustentable de la movilidad basada en la creencia de que el proceso de planeación urbana no debe ser objeto del pensamiento individual en busca de acercamientos de impulso al tráfico; por el contrario el seguimiento del nuevo urbanismo, el cual alienta los barrios compactos, densos y de uso mixto que a su vez marcan las premisas correctas para la aplicación de una forma de transporte original, caminable y de fomento al ciclismo y al transporte público como medios de movilización favorecidos. La particularidad de MIC yace en la combinación de los principios previamente mencionados y del entendimiento de la necesidades de sus cliente sumado a los requerimientos de las entidades publicas, que a su vez afrontan todos y cada uno de los temas relacionados a los medios transporte, desde impacto del trafico hasta estudios de ingenierías civiles.

Team
Federico Parolotto / Francesca Arcuri / Jelena Crnogorcic / Carlotta Bonvicini /Claudio Minelli / Nicola Tedoldi / Sebastiano Scacchetti

Studio FM milano srl
www.studiofmmilano.it

Studio FM Milano es una oficina de diseño grafico líder. Con sede en Milán, Italia, se especializa en diseño grafico, con especial atención a dirección de arte, identidad corporativa, libros, exhibiciones e instalaciones tanto de diseño así como diseño web. Los proyectos de Studio FM han recibido numerosos galardones incluyendo el European Design Award en el '08, '09' y '10 en Estocolmo, Zurich y Rotterdam.

Team
Sergio Menichelli / Luca Terraneo

THE TEAM

carlorattiassociati srl
Walter Nicolino & Carlo Ratti

carlorattiassociati | Walter Nicolino & Carlo Ratti is a rapidly growing architectural practice that was established in the summer of 2002 in Turin, Italy. Drawing on Carlo Ratti's research at the Massachusetts Institute of Technology, the office is currently involved in many projects in Europe, America and Asia. The work of the practice aims to revolutionize how we use urban informatics in architecture, working at every scale towards a future that is socially, economically and environmentally sustainable. Among the most recent projects are the design of the headquarters of the leading Trussardi fashion house in the center of Milan, Italy, 1000 Tsunami-Safe(r) houses in Sri Lanka, the Cloud for the London 2012 Olympics and the Digital Water Pavilion at the 2008 World Expo in Zaragoza, Spain. The office is also currently involved in the design of new cities in the Gulf region and Central America. The practice, selected in 2004, 2006 and 2010 for The Venice Biennale exhibition as one of the top offices in Italy, has received many awards, including Time Magazine's 'Best Invention of the Year' - and its work has been featured in leading publications worldwide, including the New York Times, the Boston Globe, Der Spiegel, Discovery Channel, BBC, Domus and Abitare.

Team
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together with:

Prof. Dennis Frenchman

For this project, CRA will be joined by Professor Dennis Frenchman of MIT, who played a central role in the selection of the Parque Morelos site, development of Strategic Guidelines, and urban design of CCD. Professor Frenchman is among the world's leading authorities on the design and development of digital media and creative cities, and the digital public realm. Among his experience is design of the Seoul Digital Media City in Korea; Mila Digital in Zaragoza, Spain; Media City: UK, Manchester; Twofour54 Media Zone in Abu Dhabi. At MIT he is director of the Centre for Advanced Urbanism and co-Principal Investigator on Making Clean Energy Cities in China, a major study for the Energy Foundation.

accenture
www.accenture.com

Accenture is a global management consulting, technology services and outsourcing company, with more than 257,000 people serving clients in more than 120 countries. Combining unparalleled experience, comprehensive capabilities across all industries and business functions, and extensive research on the world's most successful companies, Accenture collaborates with clients to help them become high-performance businesses and governments. Accenture is a Fortune 500 company listed on the New York Stock Exchange. The company generated net revenues of US$27.9 billion for the fiscal year ended Aug. 31, 2012. Accenture's global Intelligent Cities practice is composed of experienced professionals dedicated to the urban development agenda. They have City projects either ongoing or recently completed in Latin America, Asia, Europe and the Middle East. The work within Intelligent Cities is vendor-agnostic and value-driven. They work with cities to identify their challenges and opportunities and to develop architect relevant and pragmatic solutions. They focus on helping cities to realize the strategic value of ICT in solving urban challenges, working at the apex of physical and digital design; not only focused on technology solutions, but also on the important 'softer' components of business model, governance model and financing strategy innovation, which enable long term socio-economic and environmental value creation. Accenture has offices and operations in more than 200 cities in 54 countries. In this case they will team local market expertise and experience with their global Centre of Excellence in Intelligent Cities based in London and technology experts from the US.

Team
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Arup
www.arup.com

Arup is a global firm of designers, engineers, planners and business consultants providing a diverse range of professional services to clients around the world. Arup have more than 10,000 staff located in 92 offices in 37 countries; at any one time, working on over 10,000 projects in the fields of design and construction. Arup are renowned for their specialist expertise in multiple disciplines encompassing all aspects of the built environment. At the same time, they are dedicated to an interdisciplinary approach that brings their full range of skills and knowledge to each project. Since their inception in 1946, they have been the creative force behind many of the world's most innovative and sustainable designs. Arup has three main global practice areas: buildings, infrastructure and consulting. Although their multi-disciplinary approach means that any given project may involve people from any or all of the sectors in which they operate, their fundamental aim is to bring together the best professional team in the world to meet the clients' needs. For this project Arup has assembled a team of experts in Sustainability, Urban Infrastructure and Urban Informatics. The team draws from staff in our Madrid, London and New York offices.

Team
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Fundación Metrópoli
www.fmetropoli.org

Fundación Metrópoli is an international organization, at the forefront of a new generation of "intellectual capital institutions" that aspires to contribute to the innovation and development of cities and regions through the research, sharing and implementation of knowledge, and with the objective of building a sustainable future. The aim of the Fundación is to be a catalyst for the positive transformation of cities and landscapes in the 21st century. Based in Madrid (Spain) since 1997, the Fundación Metrópoli originates from the first ever 'City Science Center' founded by the University of Pennsylvania, USA. No single institution can respond to the complexity of the globalizing world, thus a key characteristic of the Fundación Metrópoli is to work in cooperation with a global network of excellence. It seeks partners from a wide range of places and professional backgrounds to generate knowledge towards a new spatial culture. Its action–oriented philosophy is guiding its understanding of the dynamic of cities, the connections with their surroundings, and their role in future oriented activities of 21st century society. Its overarching aim is a better quality of life enhanced by the active participation of those living, working, playing and learning in cities.

Team
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Engram srl
www.engram.it

Engram is a digital visualization office based in Italy, specialising in architectural visualization for more than 15 years. Being architects gives their work a precise shape, aiming to create emotional communication material generated from the architecture itself. Quality, reliability, strong problem-solving and tecnical capabilities make Engram Studio the choice of a wide range of architects all over the world.

Team
Paolo Zambrini / Riccardo Zema / Thomas Arici / Francesco Spendio / Samuele Ballardini

Mobility In Chain
www.michain.com

MIC | Mobility in Chain was founded on the belief that mobility influences the way we live and the quality of our lives. MIC was also created with the ambition of improving the quality of our lives through a profound understanding of how we move about. In line with their previous professional experience, the MIC team is strongly focused on international work, providing transport consultancy to developers, master planners and public bodies all over the world. MIC embraces an innovative and sustainable vision for mobility based on the belief that town planning processes should not be subject to the single-minded pursuit of traffic-driven approaches, and new urbanism, which enhances compact, dense, mixed-use neighbourhoods that in addition set the right premises to enforce the original form of transport, walking, followed closely by cycling and public transport, as the most favoured mode of movement. MIC's peculiarity lies in the combination of the principles above with the understanding of the needs of the client, and with the requirements of the public bodies dealing with every kind of transport issue ranging from traffic-impact studies to civil engineering. Based in Milan, Italy.

Team
Federico Parolotto / Francesca Arcuri / Jelena Crnogorcic / Carlotta Bonvicini /Claudio Minelli / Nicola Tedoldi / Sebastiano Scacchetti

Studio FM milano srl
www.studiofmmilano.it

Studio FM Milano is a leading graphic design office. Headquartered in Milan, Italy, it specializes in graphic design, specifically art direction, corporate identity, books, exhibit/installation design and web design. Studio FM projects have received many awards, including the European Design Awards '08, '09 and '10 in Stockholm, Zurich and Rotterdam.

Team
Sergio Menichelli / Luca Terraneo

Guadalajara Ciudad Creativa Digital

Una oportunidad de transformar nuestro futuro

Guadalajara Ciudad Creativa Digital, representa la gran apuesta de México por consolidarse en el mundo de la economía del conocimiento y la creatividad; una apuesta liderada por el Gobierno Federal y complementada con la fuerte y decidida participación del Gobierno del Estado de Jalisco, el Municipio de Guadalajara, la industria de Alta Tecnología, las Universidades y la Sociedad en general. Constituye nuestra oportunidad de consolidar a Guadalajara como el primer nodo global de Producción creativa digital en el mundo hispano parlante y en uno de los 10 mejores a nivel internacional.

A través de la estrategia Guadalajara Ciudad Creativa Digital, pretendemos no solamente la atracción de inversiones, generación de empresas, generación de empleos de alto valor agregado, incremento en la innovación y generación de propiedad intelectual; pretendemos contar con un nuevo modelo de territorio sustentable, de desarrollo integral económico- urbano-social-cultural que facilite el impulso de nuestro talento hacia una economía basada en el conocimiento. Ciudad Creativa Digital es una oportunidad histórica de transformar nuestra economía, nuestra industria tecnológica, nuestro modelo educativo, nuestro mosaico urbano y de servicios en el centro de Guadalajara continuando así la evolución e innovación de nuestra ciudad, dentro de un mundo cambiante y demandante, de competencia global y de creatividad constante.

Ciudad Creativa Digital, es además una valiosa oportunidad para remodelar nuestra ciudad como un referente de ciudad futura, incluyente y sustentable, que se pueda replicar en el resto del país para potenciar los territorios, para generar una verdadera ciudad-ecosistema de innovación y conocimiento, que genere prosperidad y gusto por habitarla, impulsando así el desarrollo de nuestra región y de nuestro México.

El Plan Maestro, presentado en este documento es una síntesis de la visión estratégica de Guadalajara Ciudad Creativa Digital, este plan maestro incorpora además los mecanismos de gobernanza, colaboración y trabajo en equipo tanto de instituciones públicas y privadas como de la sociedad civil y vecinos. El plan esta basado en las mejores practicas internacionales para el rediseño de ciudades, la creación de espacios creativos altamente atractivos con infraestructura de vanguardia para fomentar una gran calidad de vida, respetando nuestra identidad e historia; fincando en nuestras raíces culturales nuestra visión por un mejor futuro.

Un mejor futuro, esto es la Ciudad Creativa Digital, una oportunidad histórica que estamos consolidando y que estamos construyendo con pasión, energía y determinación.

Octavio Parga
Presidente de Consejo
Guadalajara Ciudad Creativa Digital AC

The opportunity to transform our future

Guadalajara Ciudad Creativa Digital, the transformation strategy for a new digital and creative cluster, is Mexico's big venture into breaking through and exploiting knowledge and creativity-based economies. It is a strategy led by Mexico's Federal Government and strongly complemented by active participation from Jalisco and Guadalajara State and Municipal Governments, as well as the regional high-tech cluster, universities and civil society in general.

Ciudad Creativa Digital represents our opportunity to consolidate Guadalajara as the first Spanish-speaking global creative and digital production hub and one of the top ten leading developments worldwide.

Through the Ciudad Creativa Digital strategy, we are pursuing not only the attraction of new investment, establishing new businesses, creating high-value-added jobs and increasing innovation and intellectual property generation, but also developing a new sustainable and integrated urban, economic, social and cultural model that will foster and drive our talent towards a knowledge-based economy.

Ciudad Creativa Digital is a unique opportunity to transform our economy, technology industries, educational model and urban footprint. This will allow us to continue to evolve and innovate our city, increasing our competitive and creative values in a constantly changing and ever more demanding global environment.

Ciudad Creativa Digital is also a valuable occasion to reshape Guadalajara to become a sustainable and inclusive model for future cities that can be replicated across the globe to generate true innovative citywide ecosystems of knowledge, prosperity and pride of living, encouraging the development of Jalisco and the whole of Mexico.

The master plan presented in this document is a compendium of the strategic vision of Guadalajara Ciudad Creativa Digital. This master plan incorporates ruling mechanisms of governance, collaboration and cross-functional teamwork of public and private institutions, as well as civil society and community members. The plan is based on top-end international benchmarks for regenerating cities, by providing highly attractive creative spaces with cutting-edge infrastructure that encourage an increased quality of living. We can achieve this while drawing on our cultural identity and history to create a healthier and enriched urban environment.

Guadalajara Ciudad Creativa Digital represents the promise of a better future; a landmark opportunity we are building through passion, energy and determination.

Octavio Parga
Chairman of the Board
Guadalajara Ciudad Creativa Digital AC

Board and advisory members / Miembros del consejo y asesores consultivos

CADELEC, Cadena Productiva de la Electrónica, A. C.
CANIETI, Cámara Nacional de la Industria Electrónica de Telecomunicaciones y Tecnologías de la Información
CCIJ, Consejo de Cámaras de Industriales de Jalisco
CONACULTA, Consejo Nacional para la Cultura y las Artes de México
Gobierno del Estado de Jalisco, Oficina del Gobernador
Gobierno del Estado de Jalisco, Secretaria de Planeación
Gobierno del Estado de Jalisco, Secretaria de Promoción Económica
H. Ayuntamiento Constitucional de Guadalajara, Presidencia Municipal
H. Ayuntamiento Constitucional de Guadalajara, Sria. de Planeación
H. Ayuntamiento Constitucional de Guadalajara, Sria. de Promoción Económica
ITESM, Instituto Tecnológico y de Estudios Superiores de Monterrey
ITESO, Instituto Tecnológico y de Estudios Superiores de Occidente
PROMEXICO
Secretaría de Economía Gobierno Federal
SHF, Sociedad Hipotecaria Federal
U de G, Universidad de Guadalajara

Special thanks / Agradecimientos especiales

3 DMX, 3D Estudios A. C.
3MB, Convergencia Tecnológica de Occidente S. A. de C.V.
ANADIC, Asociación Nacional de Distribuidores de Tecnología Informática y Comunicaciones
APZUSA, Automatización de Procesos Zugasti S.A. de C.V.
CAAV, Centro Universitario de Medios Audiovisuales
CANACO, Cámara Nacional de Comercio Guadalajara
CANACO CENTRO, Cámara Nacional de Comercio Centro
CANADEVI, Cámara Nacional de la Industria de Desarrollo y Promoción de Vivienda
CANAGRAF, Cámara Nacional de la Industria de Artes Gráficas
CESJAL, Consejo Económico y Social del Estado de Jalisco
CINVESTAV, Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional
CMIC, Cámara Mexicana de la Industria de la Construcción
COECYTJAL, Consejo Estatal de Ciencia y Tecnología de Jalisco
Colegio de Arquitectos del Estado de Jalisco, A.C.
Colegio de Arquitectos y Urbanistas del Estado de Jalisco, A.C.
Colegio de Ingenieros Civiles del Estado de Jalisco, A.C.
COMCE, Consejo Empresarial Mexicano de Comercio Exterior, Inversión y Tecnología
Comunaingeniería S.A de C.V.
Continental, Continental Automotive Guadalajara México S.A. de C.V.
COPARMEX, Confederación Patronal de la republica Mexicana
Dell, Dell México, S.A. de C.V.
Diseño y Planeación S.C
EA, Energía y Arquitectura
Empresarios Centro Histórico
EPS, Estudios, Proyectos y Señalización
Euzen
Exodo, Exodo Digital Worshop S.A. de C.V.
FOXCONN, PCE Paragon Solutions México S.A. de C.V.
Grupo Naggar Proyectos Urbanos
Guadalajara 2020
Gyroscopik Studios, S.A. de C.V.
Haiku
HILFE Consultores S.C.
HP, Hewlett Packard de México, S.A. de C.V.
IBM, IBM de México Manufactura y Tecnología S.A. de C.V.
IJALTI, Instituto Jalisciense de Tecnologías de la Información A.C.
INDAT COM
INTEL, Intel Tecnología de México S.A. de C.V.
IUSACELL, Iusacell, S.A. de C.V.
JALTEC, Sistema Universitario Tecnológico de Jalisco
Kaxan, Kaxan Games S. de R.L. de C.V.
MasFusion, MasFusion Multimedia S.C.
Mor & More
MTQ, Constructora Guadalajara
Patronato Centro Histórico
Plan V
PROPULSAR, Propulsar Estrategias y Políticas Públicas, S.C.
PUNTO ROJO, Marketing Consulting Group
Rubicon Ambiental
SCT, Secretaria de Comunicaciones y Transportes
Secretaria de Educación Jalisco
SITI, S.A. de C.V.
Toshiba, Toshiba de México SA de CV
UAD, Universidad de Artes Digitales
UAG, Universidad Autónoma de Guadalajara
UNIVA, Universidad del Valle de Atemajac
UP, Universidad Panamericana
UVM, Universidad del Valle de México
Vecinos de Colonia Centro
Vecinos de Colonia La Perla
Vecinos de la Colonia El Retiro
Vecinos del Parque Morelos
Vecinos y Comerciantes de Esteban Alatorre
Viraje, Arquitectura y Marketing

16

Sustainability in CCD

Sustainability

Overview

In 2012, Guadalajara was chosen to host the first Creative digital cluster in Mexico. The initiative reponds to the economic surge on the digital videogaming industry in LatinAmerica and the strategic position that the city seeks to atain by seting up a dedicated industry cluster in a central part of the city. The task also encompas the urban regeneration of a derilict part of the city. As part of the preparation of the masterplan, that will transform a central part of this city, there is the aspiration to introduce a new urban lifestyle by incorporating into the design a comprehensive sustainable vision that on the one hand, will meet the base requirements stated by the Planning regulations DUIS and, on the other will set a series of principles by which to bring sustainability at the root of the creation of the digital life style concept. Therefore, the sustainably vision defines CCD as a place where the digital technologies are embedded in most of the emerging sustainable strategies from the building scale up to the site wide context to define a new value proposition based on efficiency and improvments in quality of life. The vision also sets the agenda, in terms of a carbon neutral development and explores the potential best practices to achieve this. The sustainable vision for CCD masterplan in the making is anchored in three elements that were developed a previous stage of the masterplan:

1. A platform for an urban operating system
2. Creating a digital lifestyle and,
3. A responsive environment in the public realm

The combined effect of these three elements would provide:

- an attractive place to live, work and play,
- will minimize the impact on the environment and;
- will promote technological innovation at various levels.

Moreover, it will allow CCD to attract human capital and private sector investment for their green credentials on its offer on both, buildings and public realm, a clear and open accountability in their carbon emissions as well as attract investment through a different carbon trading schemes.

The sustainability strategies for CCD comprise the following: transport and mobility,energy efficiency on buildings, site wide energy strategy, water and waste water managment, resource and Waste managment and, site wide infrastructure and utilities.

In particular, the sustainability strategy focuses on the energy aspects of the masterplan ensuring the aspirations for a high quality development is planned through the maximization of the energy efficiency for all buildings and site wide. CCD aims to become one of the site wide energy efficient districts that operates with a smart grid system. This system will allow to increase efficiencies on energy consumption, water consumption, monitor water control and water leackages. Our approach to create a sustainable scenario for CCD envisaged the full integration of these strategies to achive a truley distictive district. If adopted, all these strategies combined could create a net zero energy development and reduce the C02 emissions by a third from the business as usual case when phase 3 is fully operational. This does not account any potential off site offseting which would reduce the emissions even further.

3

Sustainability Strategies :
Energy centres (2) fully operational. Open to public
completion of project allow CCD to become net zero carbon district on energy consumption.

1. energy centre for public realm services operational
2. Energy efficiency on buildings for this phase in place allowing 40% reduction on energy demand

2

Sustainability Strategies :
Micro smart grid in place
Smart grid energy centre operational
information display for public interaction on: energy efficiency, water consumption, security and digital urban applications

1. Energy efficiency on buildings for this phase in place allowing 40% reduction on energy demand
2. On site waste recycling point and collection centre
3. in place electric charging point for cars and bicycles on street
4. Smart grid energy centre built and operational to manage feed back energy surplus from buildings into the CCD network

1

Sustainability Strategies in place for net zero carbon development on buildings;
First 3 buildings to be designed with sustainable targets in mind
Parque Morelos incorporates sustainability measures on: energy efficiency -lighting, water managment and wireless connectivity

1. Infobox fully operational with 100% energy supplied by renewables sourcesInfobox fully operational with 100% energy supplied by renewables source
2. Microclimate; protection on the ramblas for direct sunlight through a responsive shading system
3. Energy efficiency on buildings with solar panels and pasive design allowing 40% reduction on energy demand

0

1. Parque Morelos

16.1.

Sustainability Vision

17.1.1. Overview

VISION

CCD will become an urban hub where sustainability is presented in real time and in the physical layers. The key aim is to try to achieve carbon neutrality in operations when CCD is fully developed.

The core principles are to use new technologies to increase infrastructure efficiency, create value with a new set of sustainable digital tools and become a replicable model and solutions.

The CCD Masterplan proposed a sustainable approach that integrates in the development plan in four key perspectives:

People – involving people throughout the process

Socioeconomic – always linked to stimulate the local business economy

Space and environment – create sustainable places within CCD

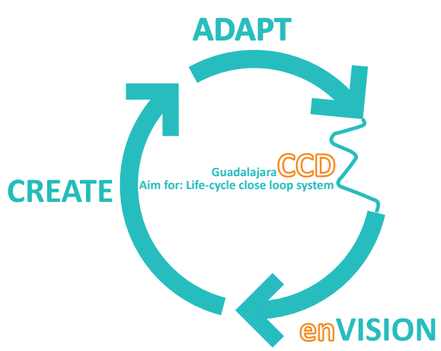
Time – planning for a temporal transitory development and resilient urban place.

KEY PRINCIPLES

The principles that encapsulate this vision have been driving the evolving concept masterplan. They are set to position CCD at the highest aim on sustainable development and fundamentally they inform the design focusing on performance for specific measures and the use of resources efficiently:

1. Set up an Urban Operating system for infrastructure that brings together the hardware from the various utility and public services and make them work more efficient;
2. Create a physical environment suitable to allow a Digital Life style in the public domain that will allow users and residents to experience urban informatics devices and services and interact with the urban context in real time in real space.
3. The district will develop a reduced Energy usage, developing local, decentralized sources of renewable energy supply and minimizing embodied energy of construction materials.
4. Minimizing Water consumption. As water is truly treated as a precious resource, CCD aims to recycle waste water and rainwater for irrigation and secondary uses.
5. Waste is minimized, and serves as a resource for energy production.
6. Local biodiversity is supported through public parks, ecological corridors, green roofs, and communal spaces.
7. Compact, mixed use communities are built at the pedestrian scale with safety in mind. Residents can conveniently access work, public services, shops, and green spaces through a network of walking and cycling paths and frequent public transport.
8. Healthy communities are established where residents of all ages can enjoy a variety of recreational activities.

> “The CCD core sustainable principles are using new technologies to increase infrastructure efficiency and create value through a new set of digital tools”



16.2.

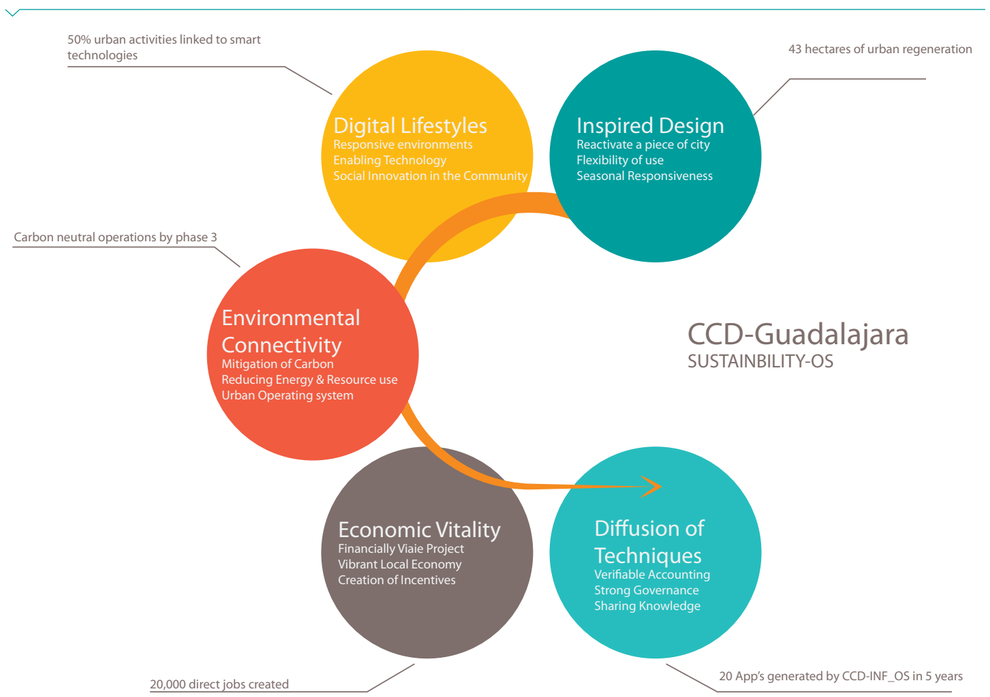
An Integrated Approach

THINK HOLISTICALLY

The ability to think systemically is about understanding buildings, urban blocks, districts and cities as an organism where linear processes are replaced by circular processes mimicking principles found in nature. Additionally it also reflects a comprehensive understanding of resource and material flows, energy balances and carbon so that our strategies are most effective to achieve agreed sustainability goals.

APPROACH TO CARBON FOOTPRINT

The approach taken to understand the impact of our site and how to address it is based on honest accounting, this means that we have considered for CCD CO2 equivalent emissions coming from: buildings and public realm; transport; food; consumer goods and services and; embodied energy of materials for construction.



16.3.

The Carbon Story

16.3.1. Overview

CCD: FROM BUSINESS AS USUAL TO CARBON NEUTRALITY IN URBAN INFRASTRUCTURE AND BUILDINGS

The annual estimated generation of greenhouse gas emissions for the project could go up to 80,000 tons of C02 after the compleition of phase 3 -as a Business as Usual project. We have envisaged that , there is the potential to reduce this to 50,000 tons of C02 without any carbon offsetting. With carbon offseting mainly on buildings and infrastructure, CCD could become a carbon district neautral.

Given our residential population of about 5000, the greenhouse gas emissions translate into a footprint of 16 tons per capita after the full completition of the project. The carbon footprint for someone who lives and works on site would come down to 10 tons per capital without any carbon offseting.

The carbon footprint calculation covers all the potential sources of carbon related to activities on our site- from embodied energy to operational energy use for buildings, infrastructure and transport to carbon emissions associated with lifestyle, including food and drinks, goods and services. Embodied carbon has been spread over a 10 year period and an allowance for refurbishement has been included.

The project has been planned to minimize carbon emissions from the start through the design of a highly energy efficient building complex in particular to the three main elements proposed during Phase 1 of development. Over time carbon emissions will decrease further by reducing energy and transport demand, decarbonising the local energy supply, encouraging use of electric drive and alternative fuels for transport, and encouraging more sustainable lifestyle choices.

To achieve carbon neutrality and eventually move towards carbon negativity, it is proposed a revolving fund that could be established to invest in off-site projects that can most efficiently offset remaining carbon emissions (for example waste to energy plants in combination with the wider DUIS initiative plans). Our initial analysis indicates the optimal year to invest in the off-site project is 2017.

ROADMAP TO NET ZERO ENERGY DEVELOPMENT

We will seek to expand and control or influence in the following key areas of focus for design:

Building energy demand reduction (control)
On-site energy generation (control)
Lifestyle choices related to consumption of food, goods, and services (influence)
Low-carbon transport strategies (influence)

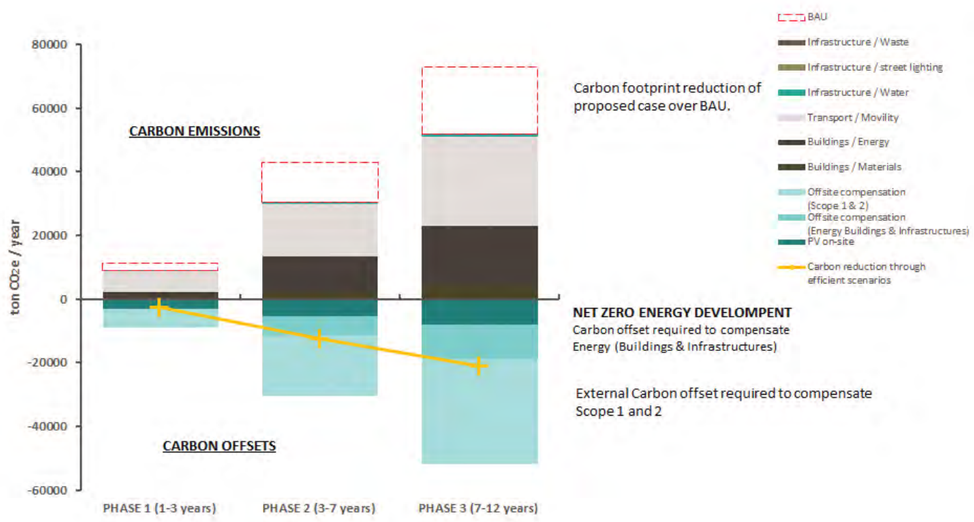
For the study of the roadmap to Carbon neutrality it has only be taken into account scopes 1 and 2, which are either under control of the CCD authorities or can be highly influenced by them.

- For the study of the carbon footprint the following scenarios have been considered:
- Buildings construction materials
- Reduction by restoration of existing buildings
- Reduction by low embodied carbon construction
- Buildings energy consumption
- Reduction by use of passive design
- Reduction by use of efficiency measures
- Transport & mobility
- Reduction in private transport use
- Reduction by introduction of congestion charge
- Infrastructure / Water
- Reduction by water fittings efficiency
- Reduction by water efficiency and 50% on-site treatment
- Infrastructure / street lighting
- Reduction by efficient street lighting
- Infrastructure / Waste
- Reduction by waste diversion
- Reduction by waste diversion + biogas power plant
- PV on-site and off-site

The roadmap to carbon neutrallity envisage CCD will have control over the following aspects:

Scope 1 & 2 (control)

- Buildings / Materials
- Buildings / Energy
- Transport / Mobility
- Infrastructures / Water
- Infrastructures / Street lighting
- Infrastructures / Waste



16.3.2. Carbon metrics

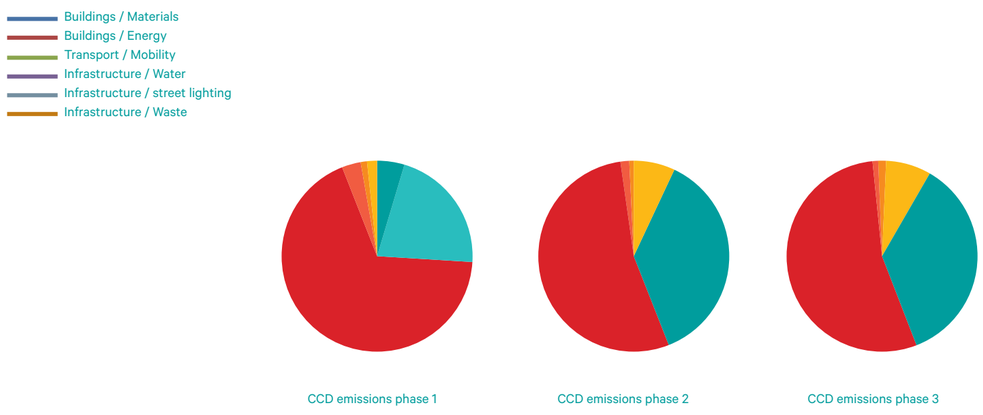
EMBODIED IMPACTS (MATERIALS) ON BUILDINGS
Embodied carbon is reduced 45% from a typical building. This amount is incurred in the phase, but has been spread over a 10 year period. An allowance for refurbishment has been included.

GOODS & SERVICES
Carbon emissions from goods and services reduce over time as residents become more aware of the impact of their lifestyle choices. Access to local retail cooperatives and "product service" companies contribute to this reduction.

MOBILITY AND LOGISTICS
Transport emissions reduce over time by collocating residents where they work and by taking advantage of the good transit options, proximity to city centers, infrastructure and the mobility plan for CCD. Electric vehicle car clubs, and low emissions policies further reduce emissions for transport.

BUILDING ELECTRICITY, COOLING
Narrow floor plates enable natural ventilation and enhance daylight to help reduce dependence on artificial systems. Interconnection with the smart grid system from phase 1 will mean efficiency on energy consumption and the net energy balance with the operator. The building will be fitted with very efficient passive design systems and the facades with incorporate natural ventilation to maximize air circulation.

URBAN INFRASTRUCTURE
Upgrade on water, waste and street lighting infrastructure will help to reduce the emissions which are not from buildings. Although the number is not big, it will contribute to reduce the overall carbon footprint in operation.



16.3.3. Carbon story: net zero requirements phase 1

EMBODIED IMPACTS (MATERIALS) ON BUILDINGS
Embodied carbon is reduced 45% from a typical building. This amount is incurred in the phase, but has been spread over a 10 year period. An allowance for refurbishment has been included.

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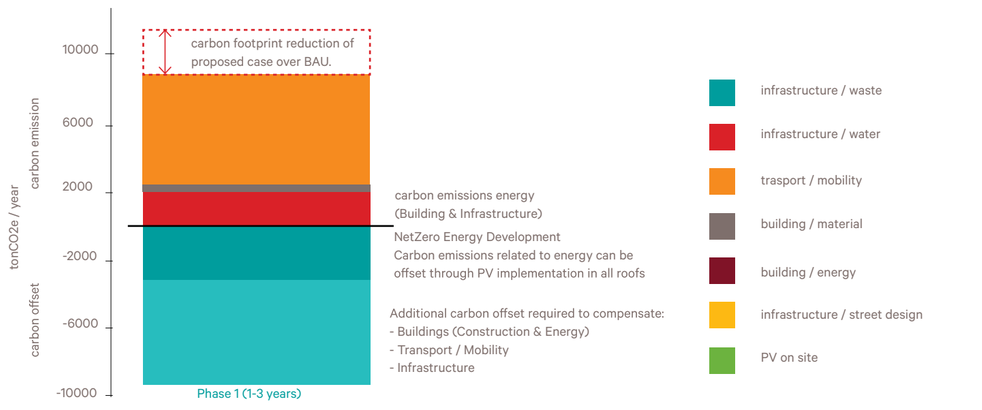
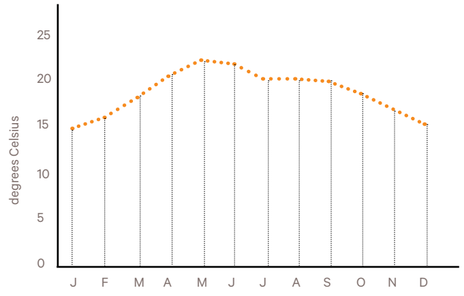


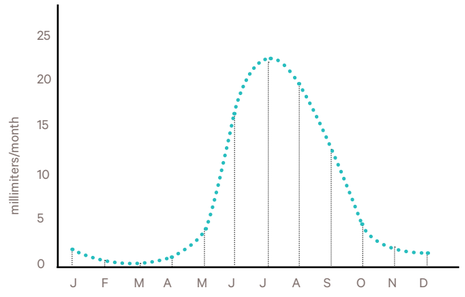
16.4.

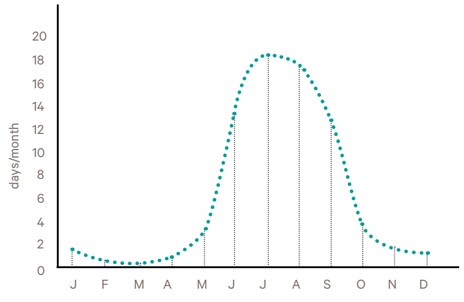
Site Conditions and DUIS Requirements

16.4.1. Summary of site conditions

The area where the CCD hub is located lies within the central perimeter of Guadalajara. Its proximity to a very rich and diverse cultural environment makes the project area quite sensitive in terms of urban regeneration strategies. During 2011, the Municipal government launched and prepared a strategic urban plan to comprehensively regenerate a wider urban area.
As a result of the strategic plan, this wider area became designated as a DUIS (Desarrollo Urbano Integral Sustentable) zone of which one of the six districts is the area for the Digital Hub.
The site designated as the digital hub comprises an area of approximately 50 hectares where 37 urban blocks partially contain existing buildings. The Parque Morelos, lies at the center of the project area and it is one of the main public spaces in the central part of the city. Originally a river bed, Av Independencia now is one of the most heavily traffic routes through the city centre. Although the project site contains mainl y one or two stories buildings, the prevailing winds direction could maximize the opportunities for mix mode ventilation in the design of taller buildings.







16.4.2. The DUIS requirements

This framework has been applied at a larger scale. As the digital hub is the first development coming forward, the DUIS would now be updated with the emerging technical strategies developed for CCD. As a starting point, 20 fichas has been submitted in draft version to inform the development of the sustainability strategies. The main that have been covered are:

- Neighborhood structure
- Connectivity and accessibility of the neighborhood
- Equipment neighborhood
- Land uses by sector
- Density by Sector
- Design of public space
- diversity
- dentity
- basic infrastructure
- Solid Waste Management
- ICT accessibility
- Conditions for occupancy

Also there are a set of guidelines that should inform the architectural design of the various elements within CCD. They are basically guiding principles and relate to the following aspects:

- Design of green spaces
- architectural Design
- Design according to heritage and cultural identity
- Efficient use of energy
- Efficient use of water
- solid Waste
- ICT services

The Sustainable approach for CCD has taken as benchmark the requirements stated in the DUIS documentation. The sustainability strategies for CDD have the aspiration to improve on the following aspects:

- Water consumption U14 / B9
- Recycle water U14
- Waste management U16 / B10
- Energy efficiency on buildings U15
- On site renewable energy generation U15 / U13
- Public transport U6 / B2
- Public lighting B9
- Green public spaces U10 / B6
- Digital infrastructure systems U17 / B11

Following the site analysis and reviewing the DUIS requirements we have identified two aspects which the Sustainability strategies have developed in more detail. These will be described in the next section but are identified here as the guiding principles are stated in the DUIS documents.

FLOOD RISK

The north section of Parque Morelos could be prone to flooding and therefore this risk could be mitigated by creating a water retention element. At present there are no streams of rivers within 4 miles of the site but the CCD hub has the potential economic leverage to mirror green infrastructure innovation on water management. The existing climate in Guadalajara is temperate climate with humid summers that are tropical and dry, mild winters and warm, wet summers (June – Sept). It is important to highlight the very strong seasonal variation in precipitation which could also leverage the capital investment on water retention elements in the park.

WASTE MANAGEMENT

The DUIS have very high aspirations in terms of waste collection and recycle on site. However, the current municipal service for waste collection still operates on a BaU scheme with the majority of the waste disposed at Los Laureles landfill. Although there is a legal framework in place for waste segregation this will take time as it requires change on behaviour on the users. In general terms, The DUIS waste strategy focuses on waste prevention and education, separation of organic and inorganic waste, door to door collection using small trucks and small scale on site composting. Still the DUIS left out some important aspects which the Sustainability strategy for waste management will address. These are: construction & demolition waste management is not part of the DUIS requirements and an adjustment of DUIS document B10, estimate waste generation with the expected population for the CCD hub.

By reducing Flood risk in public spaces –specially in Parque Morelos, CCD could potentially provide solutions for water management on site:
The first green urban infrastructure in the city

16.5.

CCD Sustainability Strategy

16.5.1. Key objectives, targets and indicators

The overall sustainability strategy for CCD main objectives and targets are described below.

1. Carbon Neutral

Become the first net zero energy development for energy and infrastructure by 2020

2. Energy

introduce site wide energy provision twofold:
On site green energy generation by installing **100kW** with photovoltaics on building roofs and reduction in energy consumption for buildings on average **85%** from phase 1 and saving **3500 CO2** tons per year.

3. Water Managment

On site water managment with **100%** non potable water demand met with recycled water.
55% of building water demand met with recycled water
Water discharge down by **65%**

4. Waste Managment

Enable CCD to become a catalyst for change.
Reduction by **40%** on waste to landfill in **Phase 1** and **65%** by end of **Phase 2**
100% collection of all wastes.
Treat **40%** of resources from waste using on site systems.

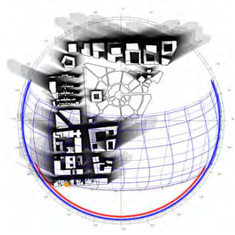
5. Telecoms and Digital Platforms

Position CCD as the first district with a 100% integrated digital service platforms for:
- Urban utilities
- Core industry
- General users

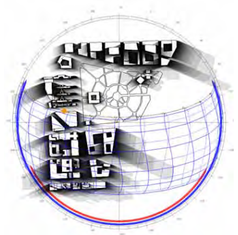
16.5.2. Digital lifestyle and microclimate design

Urban bioclimatics. SUNLIGHT AND SHADING
As a guiding principle from the concept masterplan, all public spaces should embrace the possibility of becoming work spaces. For this, in Guadalajara to happen, the shading elements in public spaces becomes a fundamental element of design.
By installing solar protection elements, public spaces will have the possibility to reduce solar radiaition in the summer in order to increse the level of confort. The figures on the right illustrate the potential risks of shading when there is no provision in the summer or totally shaded spaces in winter.

Summer shade, discomfort zone without any solar protection



Winter shade, discomfort zone

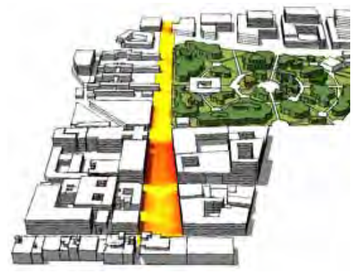


ANALYSIS FOR SUMMER SOLSTICE (21 JUNE)

Public spaces could reduce solar radiation in summer up to a **20%** by installing solar protections in order to increase the comfort.

Natural ventilation has been widely used in Mexico in the so-called “casa patio”. The distribution of openings, in conjunction with the fountains and plants favors the reduction of temperatures.To enhance the outcome of this strategy, it should be studied the precise mechanisms of natural ventilation, materials, colors, finishes, openings and prevailing winds.

In the Psychrometric chart it can be observed that with natural ventilation the higher temperatures of the year can be attenuated and brought into the comfort area



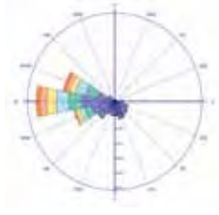
URBAN BIOCLIMATICS: WIND ANALYSIS

Building typology should Allow diagonal SW-NW wind openings. As guiding principles there should be different heights opposite buildings to create a natural flow of air between the building parcels. In the open spaces, courtyards, patios, etc., a potential provision for minor wind barriers such as tees and obstacles should be placed at the indicated sites in order to prevent the wind tunnels in winter. In summer, trees could be pruned to allow natural ventilation.

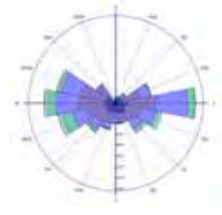
Analysis for W-E winds. Speed considered 3m/s

10m/s

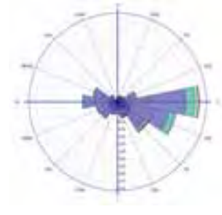
0m/s



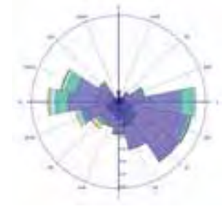
Spring



Summer



Autumn



Winter

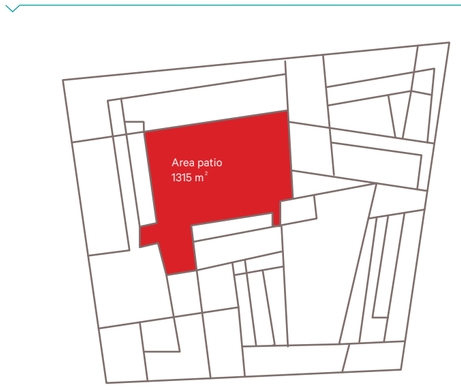
16.5.3.
Sustainable design guidelines at building and block level

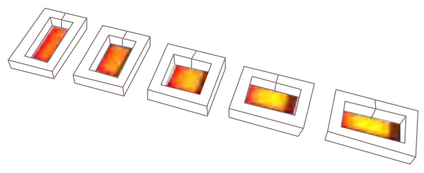
The number of hours occupants spend in the courtyard is directly proportional to how comfortable the space is throughout the year.
The mild winter temperatures together with the sun radiation will create a comfortable space. In the summer, due to the high dry-bulb and mean radiant temperatures it is required the use of shading devices to enhance comfort.
As part of the Sustainability approach, the concept masterplan for CCD is proposing a series of design guidelines to improve the natural ventilation, sun light penetration and levels of confort. These guidelines have been applied at two levels:
At a building level

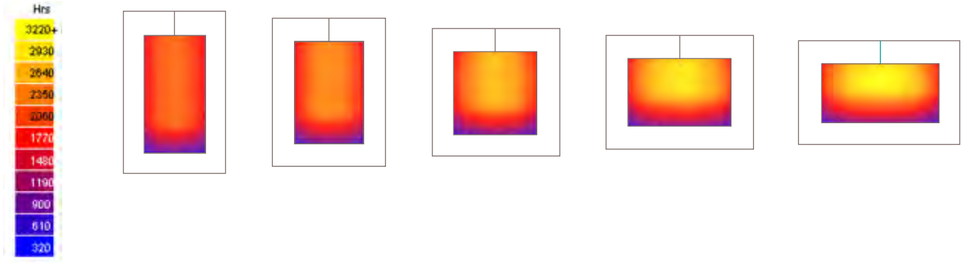
In the graph below it is shown the influence of the shape of the courtyard in the number of hours it receives sun. While the E-W axis provides more isolation in the colder months, the N-S axis will provide more shading in the summer.

It has been estimated that thought-out the year cases a) and e) give similar number of hours of comfort (aprox. 4000 h), as winter and summer are balanced

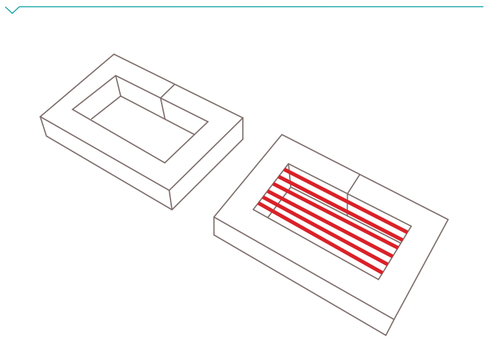
It has been considered the courtyard is only used between 8:00 to 22:00 hours (5110 h/year). Internal finishes have been simulated as gypsum. Courtyard floor is half tile half grass.

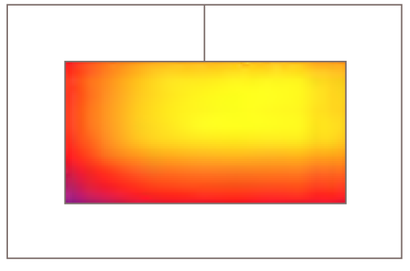


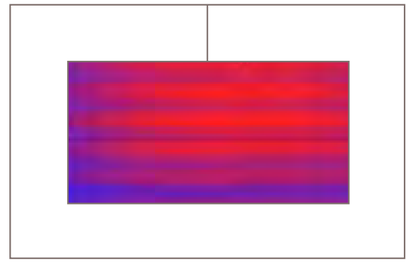




It is estimated that, for the east-west axis courtyard, there are 620 hours in the year in which the sum of external temperatures with solar radiation creates overheating, making the courtyard too hot to be comfortable.
By introducing shading devices in the courtyard, comfort can be increased by 310 hours, of which 160 hours of increased comfort are related to the months April, May and June In the graph next page it is shown the number of hours of isolation with and without shading devices- It has been considered the courtyard is only used between 8:00 to 22:00 hours. 5110 h/year).







MICROCLIMATE COURTYARD STUDY

The traditional Mexican "casa patio" incorporates evaporative cooling as a mean to reduce summer temperatures. The evaporative cooling can be introduced in the courtyard through water ponds, fountain or misting elements.
Their cooling output is highly dependent of air and water temperature, solar radiation, relative humidity and wind. To achive this cooling effect two natural devices could be incorporated into the design of the courtyard:

1. POND

Where the main specifications would be:

- Do not require constant pumping
- Consume less potable water that fountain
- Output highly influenced by solar radiation
- Increase comfort in aprox. 200-300 hours
- Reduces outdoor temp. by 1.3 ºC at peak

2. FOUNTAIN

Where the main specifications would be:

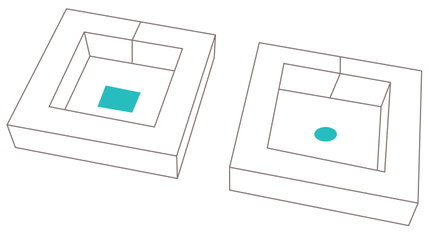
- More cooling capacity in less space
- Provides city noise attenuation
- Output highly influence by relative humidity
- Increase comfort in aprox. 400-600 hours
- Reduces outdoor temp. by 2.3 ºC at peak

Note. The pond size: 13 m x 10 m and the fountain size: 4 m diameter. Water jet size: 2m height and 3 m wide and Air speed: 1 m/s

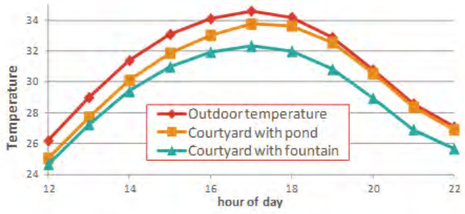
Trees and planting can significantly cool the local environment. Their impact depends on their size and location.
The temperature reduction is caused by evaporative cooling and shading of the ground. Smaller green areas spaced at intervals are preferable for effective cooling than centralized big green areas.
The major qualitative effects are:

- Shading effects due to trees: mitigation of the solar heat gain
- Reduction of surface temperatures: decreasing convective and conductive heat loads
- Reduction of radiation transmission from ground to occupied spaces by ground cover
- Plants windbreak effect: wind speed mitigation

Representation of the water features analysed



Influence of water features on temp. for summer design day



MISTING SYSTEM

Reduces outdoor temp. up to 10ºC
Evaporative rate and temperature at compressor inlet depend on:

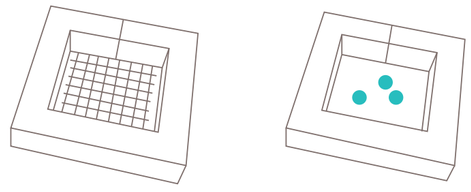
- Initial droplet size
- Initial air temp and humidity
- Concentration of water droplets and temperature in the air stream (active radius)

Mist Cooling will utilize three primary components:
- High Pressure Misting Pumps.
- Fixed Line Tubing & Nozzles
- Misting Fans (optional)

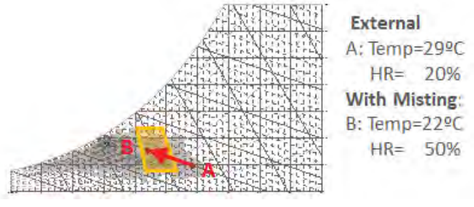
Control to be based in occupancy sensors

solid stream flat spray hollow cone full cone

Representation of the mysting grid in a courtyard



Influence of misting system on point "1" temp. for summer design day



16.6.

In Detail: NZED

16.6.1. Net Zero Energy Development (NZED)

ENERGY MAPPING IN BUILDINGS

The assesment for NZED will start by analysing the energy demand on a BaU scenario. Below is the summary table of the proposed development for CCD with the various land use elements and their estimate energy demand.

- Creative Industry
  - Office space — 80-120 kWh/m2 year
- Institutional, education
  - Tech. lab, research facility — 80-120 kWh/m2 year
  - Lecture Hall, library — 30-60 kWh/m2 year
- Shops, restaurants, services, hotels
  - Hotels — 10-40 MWh/room
  - Restaurants — 200-600MWh-rest
  - Low load shop (shoe shop) — 150-300
  - High load shop (Frozen food) — 400-600
- New residential
  - Housing — 20-30

BAU AND OBJECTIVE FOR ACHIVING LOW EMISSIONS

Objective: to achieve a Net Zero Energy Development and Carbon neutrality within the scopes under control of city authorities.

The electricity demand for the Business As Usual (BAU) scenario has been estimated in 73 Gwh/year with a related emission of 36.100 tons of CO2.

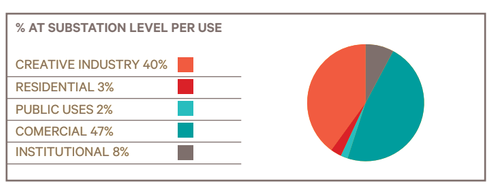
Path to Net Zero Energy & carbon neutral Development:

- Passive Urban Lay out & Microclimates
- Energy efficiency in Buildings & Urban infraestructure
- Renewable energies (onsite & offsite)

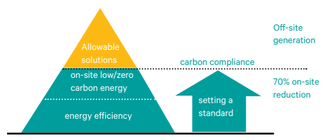
+

- Smart Mobility
- Integrated Smart Grid
- Smart Business model & Governance

Estimated distribution of energy consumption per use



Path towards Zero Carbon Buildings (proposed target)



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Energy maping BaU scenario

16.6.2.
Case study: Digital Art Institute

To demonstrate how CCD can achive this Net Zero Energy on buildings we have analyzed the case of a Phase 1 project. By implementing passive design strategies it is calculated a reduction of 22% in the energy consumption.
With the additional standard efficiency measures listed below, a reduction of 25% in the energy consumption over the BAU case has been estimated.
By installing PV and solar hot water panels in the roof, it is estimated an additional reduction in energy consumption of 38%.
For a Net Zero Energy Consumption case additional renewable energies must be installed offsite to cover the remaining 15%.

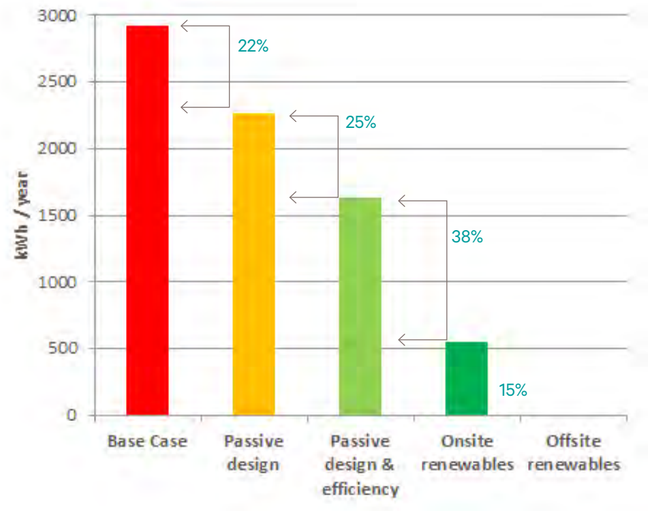
The existing building retrofit design can therefore incorporate the following pasive design principles:

- Orientation, already obtained with the existing footprint
- Shading, minor elements to be incorporated at the design phase
- Uvalues envelope, specify high stardard facade elements
- Natural ventilation, incorporate elements in the facade that can be opened.

In addition, the builiding can achieve more efficiency on energy with:

- Efficient Lighting & daylighting
- Variable speed pumps and fans
- Efficient central equipment
- Heat recovery & Freecooling in AHUs

Estimated energy consumption for the Digital Art Institute. All reductions are estimated over the BaU schenario



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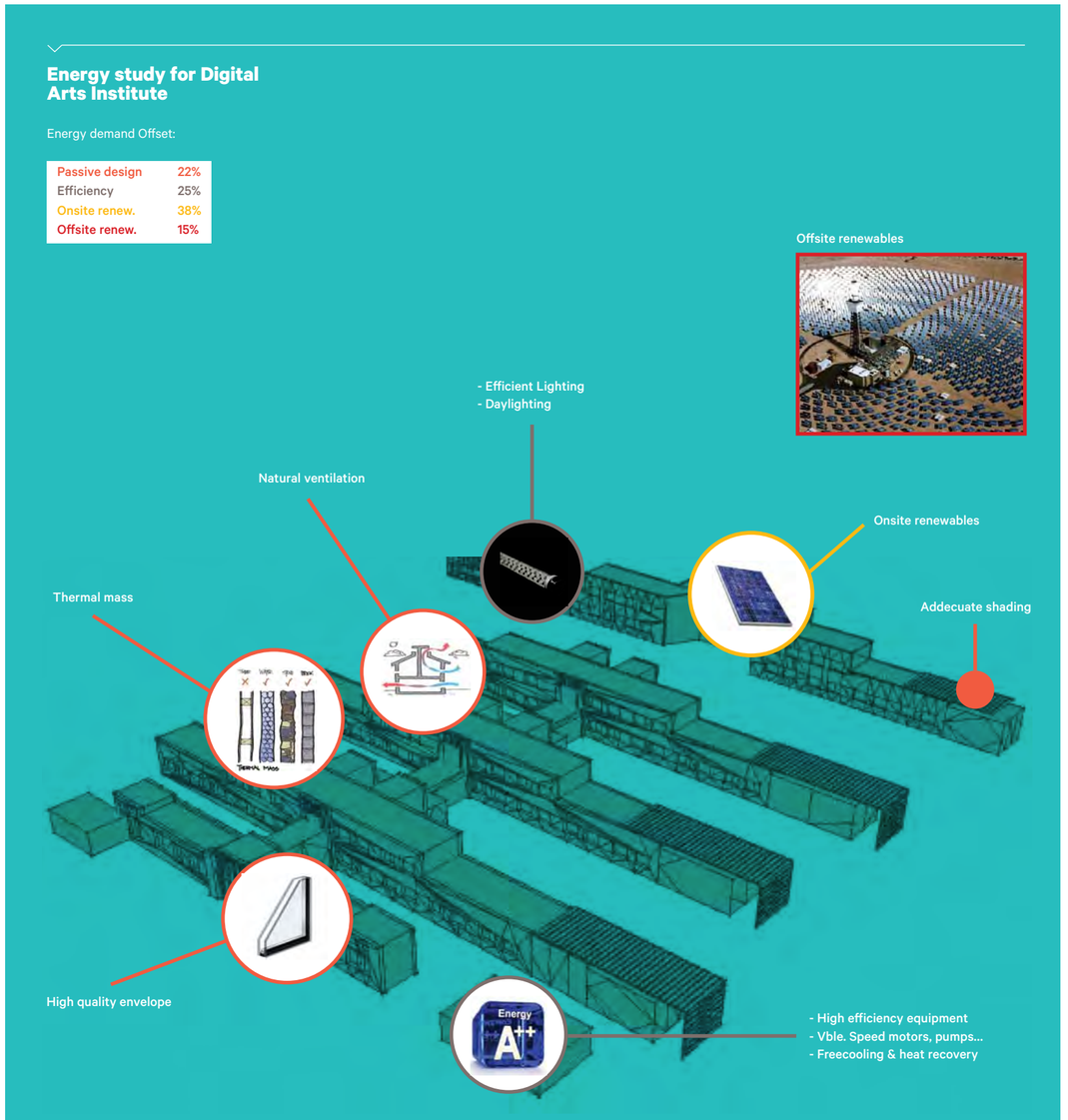
Energy study for Digital Arts Institute

Energy demand Offset:

Passive design	22%
Efficiency	25%
Onsite renew.	38%
Offsite renew.	15%



Key elements on the Pasive Design for the building upgrade will include the following:

1. Shading
Solar shading affects energy use in buildings by controlling solar gains. Guadalajara enjoys mild winters with warm, wet summers. Allowing solar gains in the colder months and avoiding over exposure in the warmer months can result in adequate comfort temperatures, reducing the need for air-conditioning throughout the year.

Due to its latitude (20° 40' N), the sun remains at high altitudes in the warmer months, which reduces the need of shading devices in the vertical surfaces. External shading devices are more efficient than internal shading devices, as they restrain the sun energy before it reaches the interior spaces.
It must also be taken into account that solar transmittance in windows decrease drastically when the incidence angle is above 60°.

Shading in main orientations
East facing facades: in the warmer months the sun will strike on this orientation from sunrise till aprox. 11 am, when the solar transmission of the glass will decrease its effect. Vertical shades facing north-east will provide shading mainly in the warmer months.

- Fin length: 500 mm; Fin normal angle: 45° with north

South facing facades: The latitude of Guadalajara together with the low solar transmission of glass at high angles makes this orientation easier to shade. Short horizontal shading fins may be installed to provide shading.

- Fin length: 300 mm

West facing facades: as in the east facing facades, the best type of shading to protect from summer but enhance passive solar heating in winter is vertical shades facing north-west

- Fin length: 500 mm; Fin normal angle:315° with north

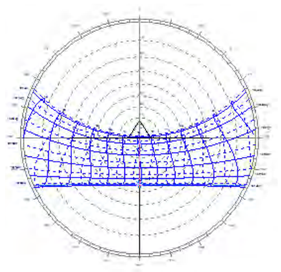
2. Thermal mass
Thermal mass is an appropiate strategy for the mild weather of Guadalajara city. To maximize the use of thermal mass, insulation must be installed as far outside as possible. Studies state that walls with internal insulation, give only 10-20% of their thermal mass to regulate internal temperatures. Walls with external insulation increase this figure up to 90%.

Office buildings: Due to the requirement for technical floors and open spaces, it is recommended the use of thermal mass in ceilings. For this all services distributed at high level have to be exposed.

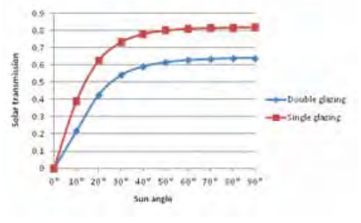
Residential Buildings: Thermal mass can be implemented in floors, ceilings or walls. Non-regularly occupied spaces: It is not recommended the used of thermal mass. Additionally to the passive thermal mass strategies a thermal active building system (TABS) should be considered at the next stage od design.

As average temp. between April to September are quite close to comfort 22-24°C and temp. difference between day and night is reduced, a thermal mass strategy can offset most of the daily temp.

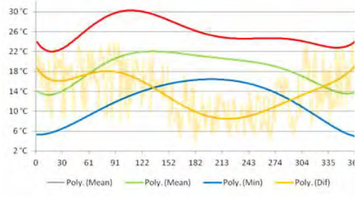
Stereographic solar chart showing solar altitude and azimuth



Solar transmittance in windows vs sun angle

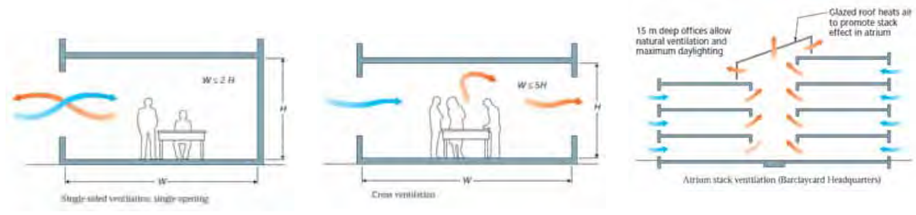


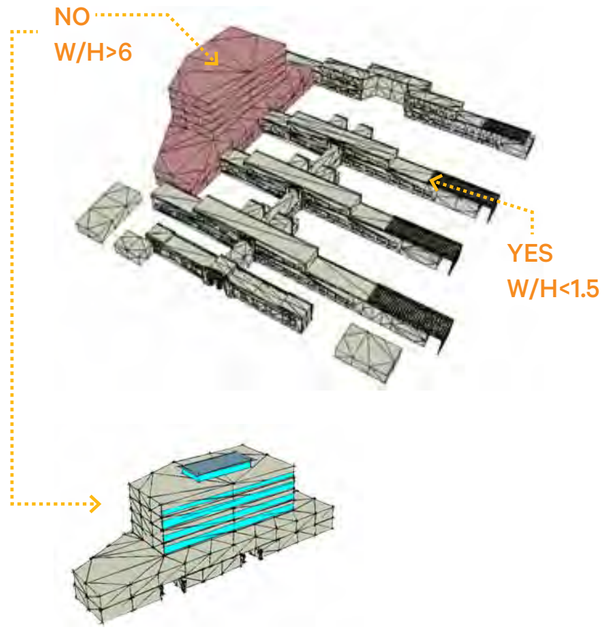
In the graph above it is shown the annual trends for daily max / mean / min temperatures and the daily difference between max and min temperatures



3. Natural Ventilation
Wind driven ventilation: The following aspect ratios must be kept. Requires unrestricted flow path.

Stack driven ventilation: Opening sizes must vary with height to achieve equal flows. It is also important the size, position and materials used in the atrium roof to maximize the stack effect and take advantage of the prevailing winds.





16.6.3. Renewable energy at block level

Solar cooling systems are able to generate cooling using the sun energy.
One of their benefits is that their peak production (peak sun radiation) is usually coincident with peak cooling demand. Solar cooling reduces GHG by not using refrigerants with high Global Potencial Warming and Ozone Depletion Potencial.

Appropiate technology for developments aming for carbon neutrality in which taking into account all externalities (like cost of displacing CO2 emissions related to conventional systems), they can compete with convetional cooling technologies.
For the CCD hub area we have analyzed several alternatives for renewable energy sources that could be integrated into more than one single building.
Below we summarize the benefits and risks associated with each source.

SOLAR (PV AND THERMAL)
BENEFITS
Easily integrated in buildings
Consolidated technology
Low maintenance
Falling prices
Government incentives

RISKS
High capital cost
Requires most roof area to offset a representable % of energy consumption

BIOMASS
BENEFITS
Easily integrated in building distribution systems
Consolidated technology
Almost carbon neutral fuel
Cost effective
Low capital cost

RISKS
High space req. for storage
Can emit GHG (NOx, CO...)

Supply in Guadalajara center
Low heating load

GEOTHERMAL
BENEFITS
No visual impact
Low space req. in building
Can provide cooling and heating
Always available

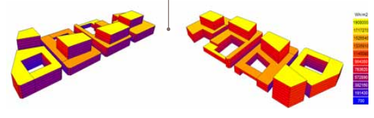
RISKS
High capital cost
“Efficient”, not renewable
Unbalanced cooling / heating load

WIND
BENEFITS
Consolidated technology
Low carbon footprint
No emits gases or contain hazardous substances
Decreasing prices
Low maintenance

RISKS
Unpredictable
High turbulence in city center
Noise

SOLAR (PV AND THERMAL)
The estimated obstruction-free roof area per building is 1.700 m², which covers only 12% of building needs;
To cover the need of each building it is required aprox. 15.000 m² of PV, which can be distributed between roofs, courtyard shading elements or other horizontal surfaces.

Total annual solar radiation analysis



16.6.4. Renewable energy Offsite

Due to the lack of land available, the full energy demand for CCD after the completion of phase 3 would continue to require energy supply from the Grid. As the aspiration to be carbon neutral in operation remains, it will require to indentify and asses the potential renewable sources offsite. Within the local context of Guadalajara the alternatives are described below.

SOLAR (PV AND THERMAL)
BENEFITS
Consolidated technology
Low maintenance cost
Falling prices
High isolation
Government incentives ??

RISKS
High capital cost
PV panles have a high carbon footprint

BIOGAS
BENEFITS
Converts waste to resource
Can be integrated with the CCD waste strategy
The generated gas can be used for electricity production or to fuel vehicles
Cost effective

RISKS
High capital cost
Emits corrosive gases

GEOTHERMAL
BENEFITS
Abundant geothermal resource in Mexico
Always stable and available source

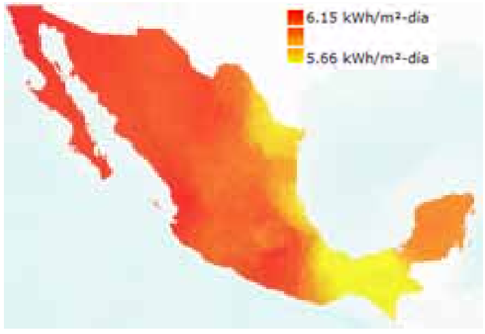
RISKS
High capital cost
Does not emit or require hazardous substances for its functioning

WIND
BENEFITS
Consolidated technology
Low carbon footprint
No emits gases or contain hazardous substances
Decreasing prices
Low maintenance

RISKS
Unpredictable
Noise and visual pollution
Not available near Guadalajara

Mexican Electric Generation
80% of the electricity generated by the National Electrical System comes from burning Fosil Fuels.
The Mexican electricity emission factor is 0.49 kgCO2/kWh, higher than most OECD countries.
The prospective of the generation mix does not predict a radical change in the tendency.

CCD has the opportunity of increase the renewables in the generation mix of Jalisco.



16.7.

In Detail: Smart Grid

16.7.1. Smart Grid

INTEGRATED SMART GRID & DEMAND SIDE MANAGMENT

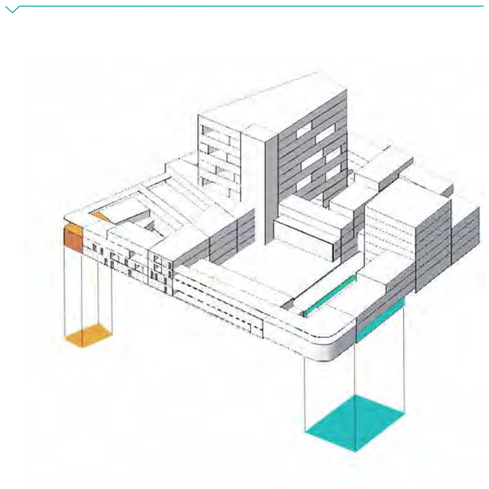
The proposal for CCD is to have an independent system to regulate demand and supply of energy site wide. This should cover all bulding energy requirements as well as requirements from the urban infrastructure and public space.
Moreover proposed, the smart grid platform should be part of the overall digital platform for services in the project.

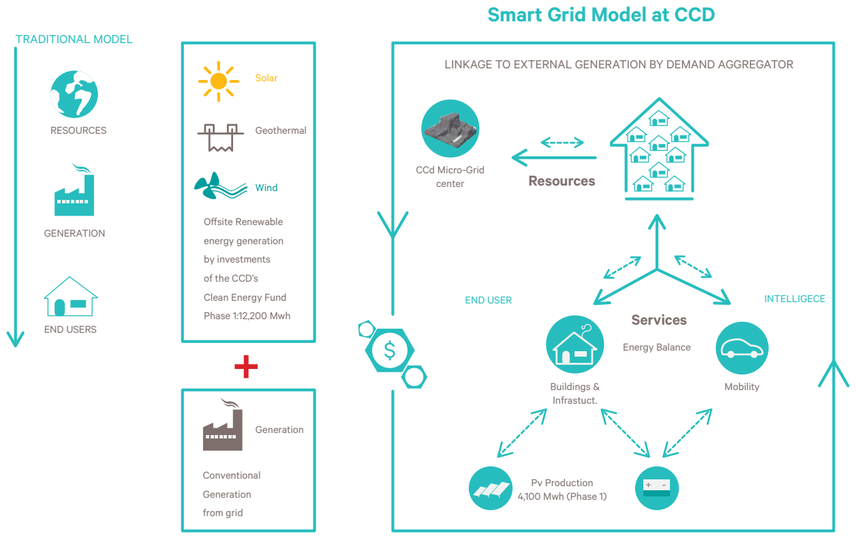
A smart grid is an electrical grid that uses information and communications technology to gather and act on information, such as information about the behaviors of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity

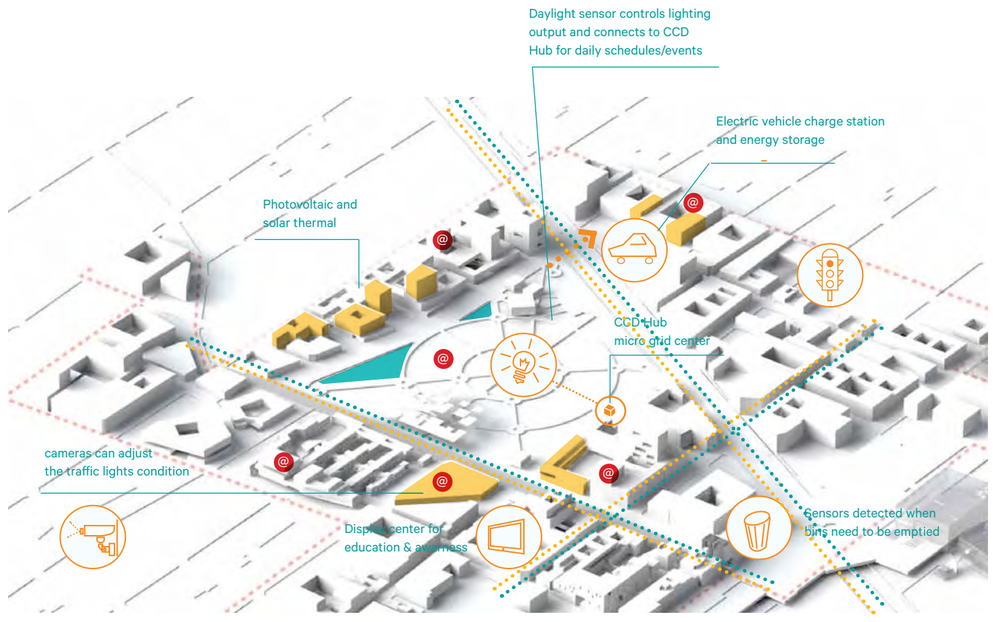
Micro-grid center: “Brain” of CCD Hub. It acts as a information aggregator. The information gathered relates to energy consumption, generation and storage. It also receives info from all sensors installed throughtout the city hub, process the information and regulates street lamps, traffic lights, parking, irrigation systems, energy storage systems, etc.

It is estimated it is required at least 1.000 m² for the data center required to aggregate all the information and offices for monitoring and real time interaction.

Educational center: Space reserved for edducational activities and show case of technologies implemented







16.8.

In Detail: Carbon

16.8.1. Carbon Inventory

CARBON STRATEGY: MULTIPLE ACTORS, MULTIPLE SCALES
Going from low to no to even negative carbon is possible-but it requires a comprehensive, innovative approach that operates at multiple scales through multiple actors. This figure summarizes the carbon reduction strategy and the impact of each component in 2017, once the CCD phase 1 development has been completed and progress has been made in the overall development of DUIS area.

The building has been planned to maximize energy efficiency, while providing an attractive facility for CCD and good quality of life for residents and workers. Its occupants will include companies that can provide services to substitute for purchase of consumer goods-such as car clubs. We will encourage staff working in the building to live there as well, as an experiment in the live/work lifestyle.

At the CCD district level, an innovative mechanism-a Climate Neutral District- is proposed to manage the revolving fund to offset emissions, create incentives to support achievement of emission reductions mainly by transport and mobility measures. To reduce transport emissions beyond what can be achieved through the CCD Mobility Plan, a low emissions transport plan will be implemented, including an electric car-share club.

The collective power of these approaches will help CCD trust, its work force, its residents as well as the greater DUIS area to dramatically reduce their carbon emissions. Remaining emissions can then be offset by cost-effectively investing the revolving fund in an off-site renewable energy proposal to be determined during the next stage of the project.

CCD CLIMATE NEUTRAL DISTRICT ON BUILDINGS AND URBAN INFRASTRUCTURE
An innovative mechanism is needed to finance and promote carbon neutrality: we propose the establishment of a CCD Climate Neutral District (CND). The CND is the most efficient and cost-effective way for CCD trust to achieve carbon neutrality in operation. The rationale behind its establishment recognizes that it does not make economic sense for CCD to invest in on-site renewable energy generation apart from transfer this investment to individual building owners; the most cost-effective strategy for CCD trust is to set aside funds that can be pooled with contributions from other sources to invest in renewable energy projects off-site. Pooling these funds (and potentially leveraging them with pubic sources) enables CCD trust to offset its net carbon emissions in the most economical manner.

The CND would be the instrument through which these investments could be channeled. It institutionalizes mechanisms that maximize the benefit of the CCD effort, and could also serve as an important instrument through which CCD trust can promote new technologies, systems, techniques and marketplace tools.
As a body with the potential to reach all residents, workers and businesses within the CCD hub (as well as visitors to the area), the CND could play an important role in communicating and promoting low carbon initiatives within the community.

The CND would be established by law with a unique charter, and be led by a Board with a representative from CCD trust serving as Chair. It would be required to achieve its carbon neutral status within as specified time of its establishment, and maintain that status throughout its existence. The CND would have the authority to impose across the district policies and fees to achieve these goals. In return the CND would enjoy special taxation privileges and similar benefits.

The **7 key leadership initiatives proposed for the CCD-CND** are as follow:

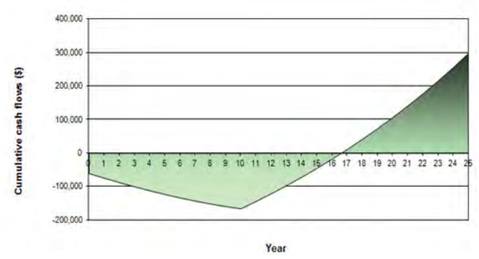
1. coordinate and implement district wide sustainability efforts across the CCD hub
2. establish a district carbon accounting system
3. establish carbon neutrality policy for new buildings in phase 1
4. create revolving fund for offset projects
5. invest in carbon abatment projects
6. help develop municipal financial scheme
7. implementing the 20 ways to change behaviour through digital lifestyle

16. 8. 2 Carbon case study

RENEWABLE ENERGY ON BUILDINGS
CCD aim to become carbon neutral should start by installing on buildings an alternative source for power from the grid. We've analyized three case study:

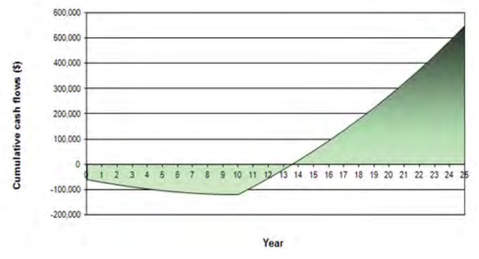
1) Medium size building with medium voltage supply:
- PV power installed: 100 kW
- Energy production: 150 MWh /year
- Tariff: H – M (>100 kW)
- Electricity price: 0.088 US$ / kWh
- Payback: 16.6 years

* This is an example of a typical building PV implementation . It does not necessarily cover all carbon emissions of building occupants and activities.



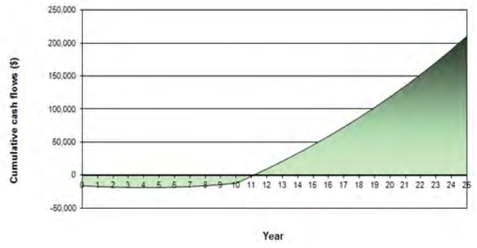
2) Small-medium size building with low voltage supply:
- PV power installed: 100 kW
- Energy production: 150 MWh /year
- Tariff: Tarifa 3 –baja tensión
- Electricity price: 0.121 US$ / kWh
- Payback: 13.6 years

* This is an example of a typical building PV implementation . It does not necessarily cover all carbon emissions of building occupants and activities.



3) Small size building with low voltage supply:
- PV power installed: 25 kW
- Energy production: 37 MWh /year
- Tariff: General low voltage (General de baja tensión)
- Electricity price: 0.169 US$ / kWh
- Payback: 11.1 years

* This is an example of a typical building PV implementation . It does not necessarily cover all carbon emissions of building occupants and activities.



16.9.

In Detail: Sustainable Block Design

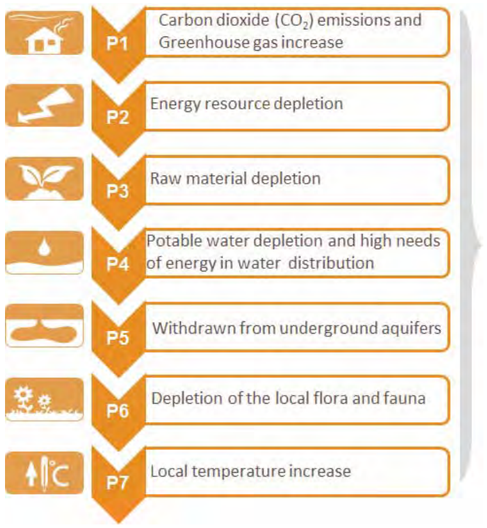
16.9.1. Sustainability at block level

CARBON STRATEGY: MULTIPLE ACTORS, MULTIPLE SCALES

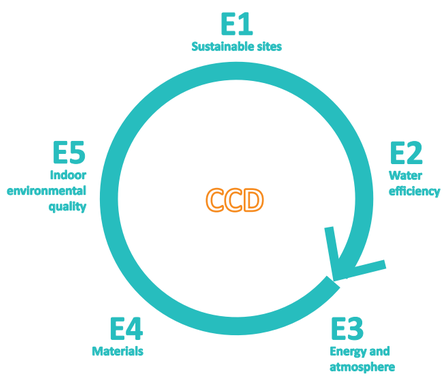
Within CCD it is intended that all new buildings aim to achive a better sustainability performance. As described in the next chapter, the aspiration is to follow LEED certification at building level for all new constructions.
However, for CCD to become truley exemplar, the various sustainable strategies described earlier, should be addressed at the block level as well.

For this to happen we have outlined the overall approach to LEED at a block level incorporating other strategies that are related to the building scale.
These are described below.

ENVIRONMENTAL IMPACT IN CCD



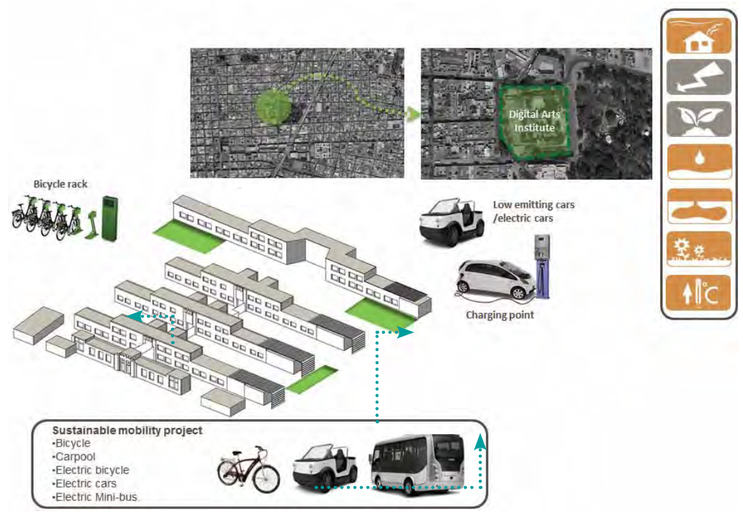
KEY STRATEGIES



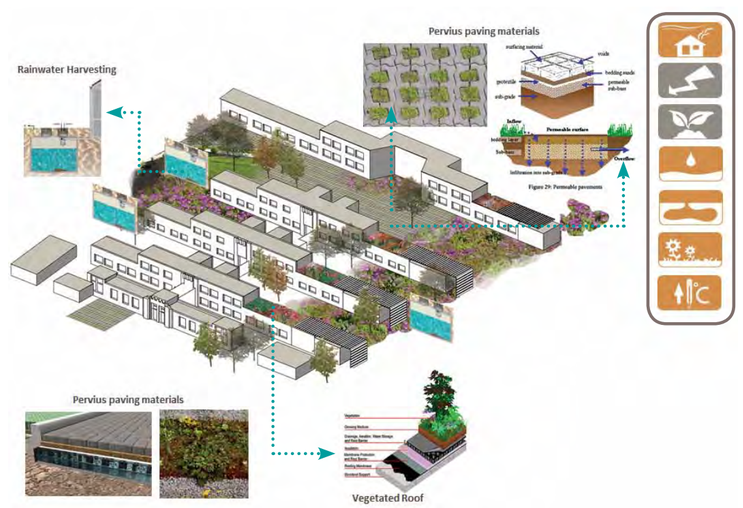
16.9.2. E1 - Sustainability Sites

Preferred parking must be provided for carpool, bicycles, low emitting cars and electric cars

Reduce CO2 emissions from car usage:
- Connectivity with public transportation
- Provide preferred parking for low-emitting and fuel-efficient vehicles
- Charging points for efficient vehicles
- Provide secure bicycle racks

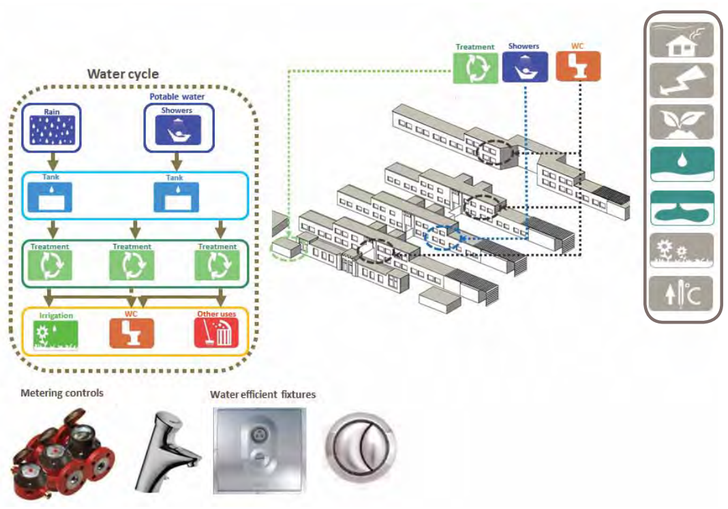


Heat Island Reduction
- Shade constructed surfaces
- Replace constructed surfaces with open grid paving or high-albedo materials
- Install high-albedo and vegetated roofs
- Stormwater mangement
- Pervius paving materials
- Infiltration swales
- Harvesting stormwater runoff



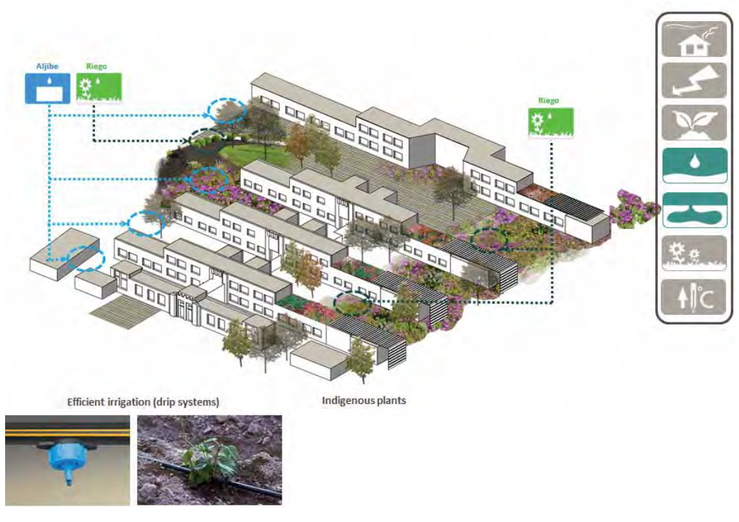
16.9.3.
E2 - Water Efficiency

Water efficiency management:
- Water efficient fixtures that can reduce potable water consumption.
- Installing low-consumption flush fixtures, such as dual-flush water closets and high efficiency urinals.
- Installing metering controls.



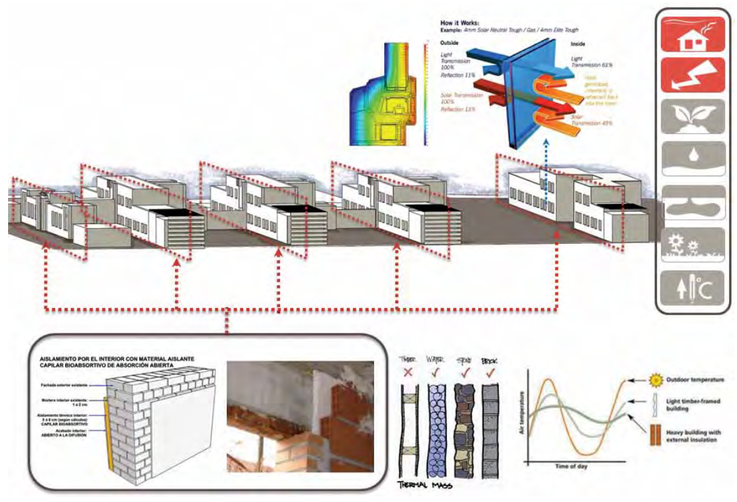
Limit or eliminate the use of potable water for landscape irrigation:
- Design landscape with indigenous plants
- Schedule watering irrigation.
- Efficient irigation practices(drip systems, moisture and rain sensors).

Reuse of stormwater / greywater:
- Collect rainwater for irrigation and WC.
- Reuse greywater from showers to fill the flush of WCs.

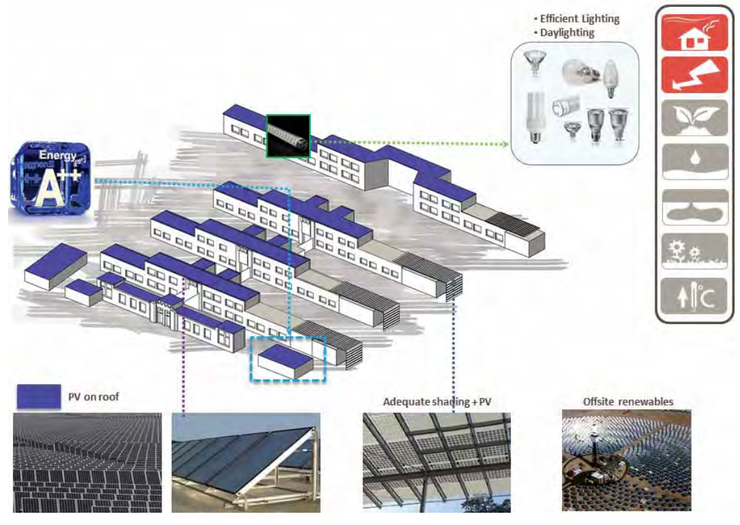


16.9.4.
E3 - Energy and Atmosphere

Pasive Design
- Increase thermal mass to provide “intertia” against daily temperature fluctuations
- Thermal insulation for the building envelop
- Specify high quality envelop
- Adequate shading



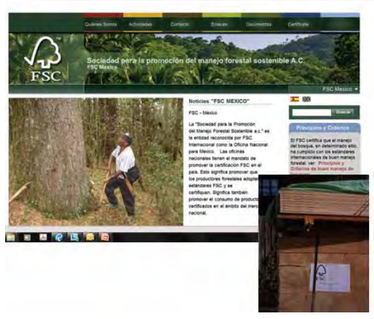
Active Design
- High efficiency on all equipment
- viable speed motors and pumps
- free colling and & heat recovery



16.9.5.
E4 - Materials

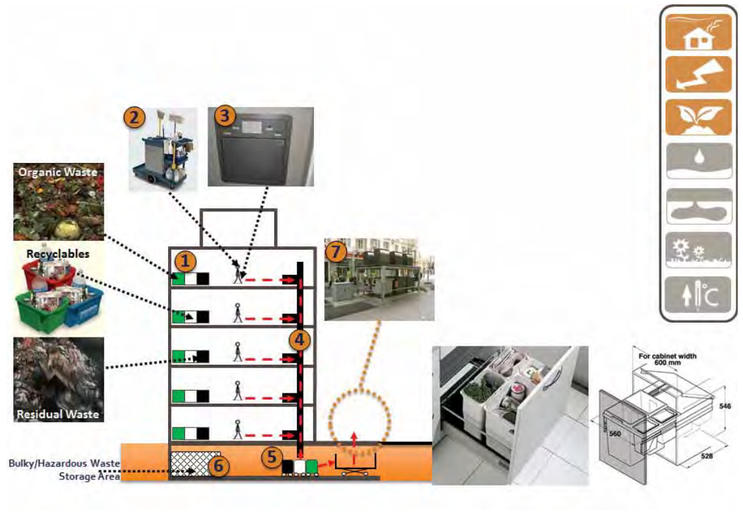
Strategies to improve the utilization of materials

- Low Embodied Energy and Embodied CO2 materials
- High thermal inertia
- Use of regional building materials
- Use of recycled content and salvaged building materials
- Prior for rapidly renewable materials s (cork, wood, ceramics)
- Use of environmental certified productos. All the wood, excepting for floor furnishing are to have FSC certificate
- Design a solid waste management policy during the construction period.



Collection & Storage - option 1 gravity chute system to basement

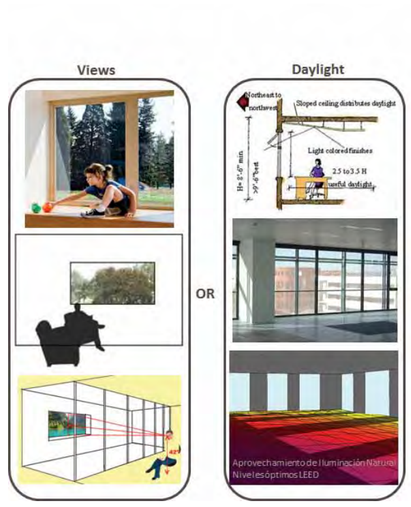
- Source separation of waste by residents/office workers
- Door by door collection of waste by janitorial staff
- Janitorial staff deposit waste in chute
- Waste travels down chute
- Manual or automatic separation of waste
- Separate storage for bulky and hazardous waste (this waste can't go down the chute)
- Hydraulic lift brings waste containers to street level for collection



16.9.6.
E5 - Indoor Environmental Quality

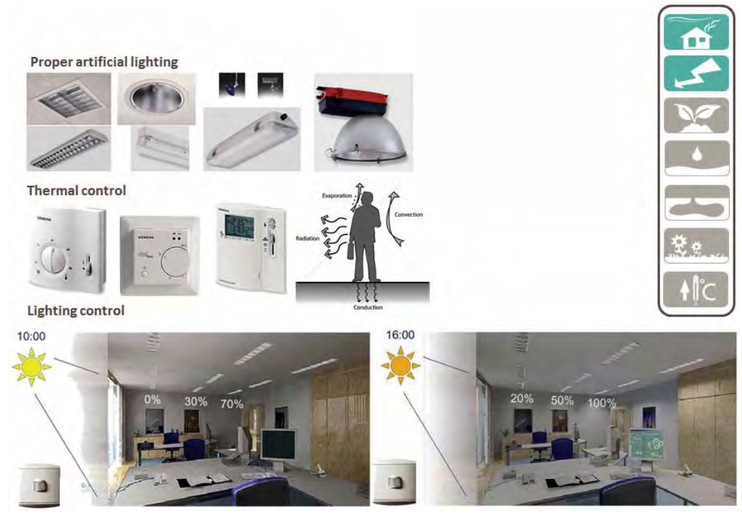
Strategies to improve indoor comfort

- Control the solar gain through windows with low emissive glazing in order to reduce light glare.
- Exploitation of natural light
- Achieve direct line of sight to vision glazing for building occupants in 90% of all regularly occupied spaces
- Achieve a minimum Daylight Factor of 2% (excluding direct sunlight penetration) in 75% of all space occupied for critical visual tasks (copy rooms, storage, laundry, etc. are EXCLUDED)



Strategies to improve indoor comfort: Lighting

- Provide individual comfort controls for 50% (minimum) of the building occupants to enable adjustments to meet individual needs and preferences.
- Provide high level of lighting control by individual occupants or groups to promote well-being and productivity
- provide a comfortable thermal environment that supports the productivity and well-being of building occupants.
- Provide operable windows



16.10.

From DUIS to LEED Certification

16.10.1. The LEED System

In addition to the DUIS Certification for the project, the CCD Site and its new or renovated constructions aspire to obtain LEED (Leadership in Energy and Environmental Design) Certification status. LEED for Neighborhood Development is a collaboration among the USGBC, Congress for the New Urbanism, and the Natural Resources Defense Council. By its own definition: an internationally recognized mark of excellence, LEED provides building owners and operators with a framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions.

This process for sustainable design will lend additional credibility to the CCD project objectives and help attract international companies who share in this mission of sustainability.

The certification process may also open the project to additional funding opportunities or international recognition beyond its initial concept and scope. As a general rule, projects which are well integrated into an existing urban context, particularly infill sites such as in Guadalajara, are more likely to obtain LEED accreditation than suburban or peripheral projects.

The LEED system is broken down into separate categories of design, based on scale and the nature of intervention that any project proposes. Within any given category, certification can be achieved by fulfilling and documenting specific design criteria, these criteria are scored as credits, and the sum of achieved credits becomes the meter for eligibility for LEED certification. Two categories for which the Guadalajara CCD project would eligible are LEED-NC (New Construction) and LEED-ND (Neighborhood Development).

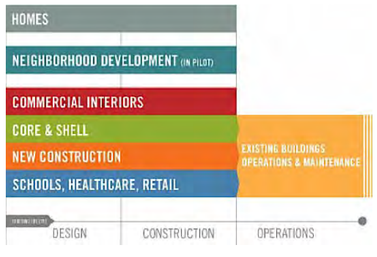
"LEED points the way towards the development of truly regenerative and sustainable communities."

U.S. President **Barack Obama,**

LEED Acredited Professional

The U.S. Green Building Council **credentials the LEED certification.**

The LEED pyramid. **USGBC**



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GUADALAJARA CCD - LEED METHODOLOGY

In order to prepare the site for LEED-NC/ND Certification the first step is to propose a methodology which identifies available credits/points and opportunities towards LEED certification. This methodology understands that particular points available in the LEED process cannot be guaranteed at early stages without final project resolution by architects, developers and builders. By identifying specific categories and points on the LEED-NC checklist, we can categorize the gap or delta remaining in order to obtain the different levels of certification (Cert., Silver, Gold or Platinum)

One of the requirements for official certification us that a LEED certified professional must supervise the documentation and execution of the project through the design and execution phases. This professional advises through project development on how to achieve targeted credits through design. The official documentation for each credit can be a lengthy and complex undertaking, as the "proof" of each point must be fully presented and approved by the USGBC (United States Green Building Council), throughout the entire the project checklist. In many cases, credits cannot be awarded until the project is b built, thus proving the conditions in question.

LEED ND (NEIGHBORHOOD DEVELOPMENT)

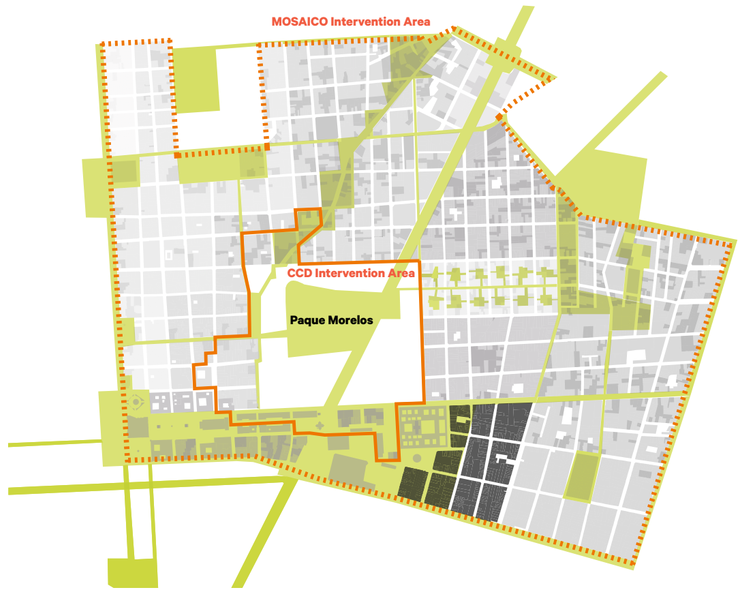
The LEED for Neighborhood Development Rating System integrates the principles of smart growth, urbanism and green building into the first national system for neighborhood design.

To earn LEED certification, the applicant project must satisfy all the prerequisites and qualify for a minimum number of points to attain the project ratings listed below. Having satisfied the basic prerequisites of the program, applicant projects are then rated according to their degree of compliance within the rating system.
LEED for Neighborhood Development certifications are awarded according to the following scale:

Points Possible: 100 + 10 bonus points

Certified: 40 – 49 pts.
Silver: 50 – 59 pts. ← Estimated LEED credit rating for which the **CCD is already eligible** (prior to physical interventions)
Gold: 60 – 69 pts.
Platinum: 80+ pts.

Urban Interventions at the scale of the MOSCAICO (380 Ha) or at the scale of the CCD project (43 Ha) are **valid for LEED-ND certification,** especially because of the amount of easily achievable potential credits for **centrality, density, walkability, and building reuse.**



16.10.2. LEED-ND Specifics

WHEN TO USE LEED FOR NEIGHBORHOOD DEVELOPMENT (TRANSCRIBED FROM USGBC DESCRIPTION)

The LEED for Neighborhood Development Rating System responds to land use and environmental considerations. It is designed to certify exemplary development projects that perform well in terms of smart growth, urbanism, and green building. Projects may constitute whole neighborhoods, portions of neighborhoods, or multiple neighborhoods. There is no minimum or maximum size for a LEED-ND project, but the core committee's research has determined that a reasonable minimum size is at least two habitable buildings and that the maximum area that can appropriately be considered a neighborhood is 320 acres, or half a square mile. A project larger than 320 acres is eligible but may find documenting certain credits difficult and may want to consider dividing the area into separate LEED-ND projects, each smaller than 320 acres. Although projects may contain only a single use, typically a mix of uses will provide the most amenities to residents and workers and enable people to drive less and safely walk or bike more. Small infill projects that are single use but complement existing neighboring uses, such as a new affordable-housing infill development in a neighborhood that is already well served by retail and commercial uses, are also good candidates for certification.

This rating system is designed primarily for the planning and development of new green neighborhoods, whether infill sites or new developments proximate to diverse uses or adjacent to connected and previously developed land. Many infill projects or projects near transit will be in urban areas, which help direct growth into places with existing infrastructure and amenities. LEED-ND also promotes the redevelopment of aging brownfield sites into revitalized neighborhoods by rewarding connections beyond the site, walkable streets within the site, and the integration of any historic buildings and structures that will give the new neighborhood development a unique sense of place.

Existing neighborhoods can also use the rating system, and its application in this context could be especially beneficial in urban areas and historic districts.

It is, however, important to point out that the owner or owners applying for certification should already own, have title to, or have significant control over a majority of the land within the project boundary and the plan for new construction or major renovation for the majority of the project's square footage. The new construction could take place on vacant land within the boundary, and the major renovations could involve existing buildings, recent or historic, within the project. In addition to guiding infill development opportunities, LEED-ND has additional relevance for existing neighborhoods, as a tool to set performance levels for a group of owners wanting to retrofit their homes, offices, or shops, and finally for shaping new green infrastructure, such as sidewalks, alleys, and public spaces.

Dockside Green in Victoria, British Colombia is one of the first projects cetified as **LEED-ND Platinum.**
VanCity Owner and Developer

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16.10.3. LEED-ND Checklist (CCD Estimate)

SMART LOCATION AND LINKAGE (18 of 27 already achieved)

			points possible
☑	☐	prerequisite 1 Smart Location	required
☑	☐	prerequisite 2 imperiled Species and Ecological Communities	required
☑	☐	prerequisite 3 Wetland and Water body Conservation	required
☑	☐	prerequisite 4 Agricultural Land Conservation	required
☑	☐	prerequisite 5 floodplain Avoidance	required
☐	☐	Credit 1 preferred Locations	10
☐	1	Credit 2 brownfield redevelopment	2
5	☐	Credit 3 Locations with reduced Automobile Dependence	7
1	☐	Credit 4 bicycle Network and Storage	1
1	☐	Credit 5 housing and Jobs proximity	3
1	☐	Credit 6 Steep Slope protection	1
☐	1	Credit 7 Site Design for habitat or Wetland and -Water body Conservation	1
☐	1	Credit 8 restoration of habitat or Wetlands -and Water bodies	1
☐	1	Credit 9 Long-term Conservation management of -Wetlands and Habitat	1

INNOVATION, DESIGN, AND REGIONAL PRIORITY (8 of 10 already achieved)

3	☐	Credit 1 innovation and Exemplary performance	1–5
1	☐	Credit 2 LEED® Accredited professional	1
4	☐	Regional priority	4

NEIGHBORHOOD PATTERN AND DESIGN (25 of 27 already achieved)

			points possible
☑	☐	prerequisite 1 Walkable Streets	required
☑	☐	prerequisite 2 Compact Development	required
☑	☐	prerequisite 3 Connected and open Community	required
10	☐	Credit 1 Walkable Streets	12
4	☐	Credit 2 Compact Development	6
1	☐	Credit 3 mixed-Use Neighborhood Centers	4
☐	☐	Credit 4 mixed-income Diverse Communities	7
1	☐	Credit 5 reduced parking footprint	1
2	☐	Credit 6 Street Network	2
1	☐	Credit 7 transit facilities	1
1	☐	Credit 8 transportation Demand management	2
1	☐	Credit 9 Access to Civic and public Spaces	1
☐	☐	Credit 10 Access to recreation facilities	1
1	☐	Credit 11 visitability and Universal Design	1
1	☐	Credit 12 Community outreach and involvement	2
☐	1	Credit 13 Local food production	1
2	☐	Credit 14 tree-Lined and Shaded Streets	2
☐	☐	Credit 15 Neighborhood Schools	2

GREEN INFRASTRUCTURE AND BUILDINGS (6 of 29 already achieved)

			points possible
☑	☐	prerequisite 1 Certified green building	required
☑	☐	prerequisite 2 minimum building Energy Efficiency	required
☑	☐	prerequisite 3 minimum building Water Efficiency	required
☑	☐	prerequisite 4 Construction Activity pollution prevention	required
1	☐	Credit 1 Certified green buildings	5
☐	☐	Credit 2 building Energy Efficiency	2
☐	☐	Credit 3 building Water Efficiency	1
1	☐	Credit 4 Water-Efficient Landscaping	1
1	☐	Credit 5 Existing buildings reuse	1
1	☐	Credit 6 historic resource preservation and Adaptive Use	1
1	☐	Credit 7 min Site Disturbance in Construction	1
☐	☐	Credit 8 Storm water management	4
☐	☐	Credit 9 heat island reduction	1
☐	☐	Credit 10 Solar orientation	1
☐	☐	Credit 11 on-Site renewable Energy Sources	3
☐	☐	Credit 12 District heating and Cooling	2
☐	☐	Credit 13 infrastructure Energy Efficiency	1
☐	☐	Credit 14 Wastewater management	2
☐	☐	Credit 15 recycled Content in infrastructure	1
1	☐	Credit 16 Solid Waste management infrastructure	1
☐	☐	Credit 17 Light pollution reduction	1

17

Urban Infrastructure: **Mobility**

17.

Mobility

Overview

The central position of the CCD master plan within the city of Guadalajara and its vocation as a starting point for a new way of living cannot prescind from a deep understanding of the city-scale dynamics, calling at the same time for the definition of wide scale mobility strategies that will guarantee a general improvement in the city's mobility conditions and therefore also a better foundation for the new development. Along with traffic management strategies such as the proposal for a reviewed interchange car park ring and a road pricing scheme for the city centre, some specific options for a better east-west public transport corridors are being proposed for CCD.

These proposals also take into account the improvement in connectivity at the scale of the DUIS polygon considering, as described, both its relation with the rest of the city and with CCD, envisaging for the enhancement of this latter connection specific mobility systems' proposals. Moreover, a general optimization of the different public transport systems and the introduction of new pilot programs such as CCD MoD and CCD car sharing, will define an efficient and user friendly mobility network in order to guarantee the highest accessibility to the site.

Zooming then into CCD, a safer and more livable pedestrian environment is presented, both through the implementation of simple and effective road design solutions, such as shared surfaces and improved pedestrian crossings, and through a revision of the site's circulation, in order to re-define the vehicular flows without penalizing those users that will access CCD with private vehicles. A solid trip generation exercise and the development of a micro-simulation model for the DUIS area are the quantitative instruments produced to define, test and verify the different circulation and network scenarios for the master plan. The model outcomes are at the base of the definition of the final and optimized layout.

Along with the circulation proposal, a consistent parking strategy has been developed. Starting from a local rate-based parking generation, specific assumptions for cross visitation, modal share and internal capture have been applied in order to reduce the master plan provision defining a more sustainable and innovative approach to mobility. Parking provision is in fact a powerful instrument in the hands of the master planner that can be used to tune and control the traffic generated by the development. Based on a shared parking approach for the retail, office and institutional functions and defining a balanced distribution of parking facilities across the master plan that work as public car parks, optimizations related to the parking occupancy profiles have also been considered.

The mobility masterplan for the CCD will define a comprehensive and multimodal frame for the public and private transport, enhancing the integration with the existing and the vision for the future.

All the above mentioned elements merge with the CCD digital platform and management system, defining one of the unique opportunities of this master plan, where the availability of real time information and smart terminals will completely change the user's perspective of the travel experience and their relation with public space. The CCD mobility digital frame will not only provide an advanced user-oriented environment, but will also improve the systems' efficiency, with a clear benefit for both providers and investors.

3

. wide scale strategies: complete dedicated bus lanes network and intechange car parks ring
1. introduction of specific public transport connections to/from the masterplan (i.e. the Airport Express)
2. quick wins strategy for ph.3: requalification of the curbs, road junctions and pedestrian crossings
3. optimization of the on-street parking and road section functional revision for the ph.3 area
4. expansion of the on-street and off-street digital parking management pilot program
5. expansion of the CCD mobility pilot programs (CCD MoD, CCD car sharing)

2

. wide scale strategies: additional dedicated bus lanes and corresponding intechange car parks; introduction of road pricing
1. introduction of specific public transport connections to/from the masterplan (i.e. the trolley bus on dedicated lane)
2. improvement of pedestrian connectivity towards plaza Tapatía and Calzada Independencia
3. quick wins strategy for ph.2: requalification of the curbs, road junctions and pedestrian crossings
4. optimization of the on-street parking and road section functional revision for the ph.2 area
5. expansion of the on-street and off-street digital parking management pilot program
6. expansion of the CCD mobility pilot programs (CCD MoD, CCD car sharing)

1

. wide scale strategies: implementation of the first dedicated bus lanes and corresponding intechange car parks
1. re-routing of the CCD bus lines and stops' optimization
2. creation of the main master plan's pedestrian connections, the Rambla and the pedestrian bridge over Hidalgo
3. quick wins strategy for ph.1: requalification of the curbs, road junctions and pedestrian crossings
4 creation of the first undeground public car parks and optimizatio of the on-street parking for the ph.1 area
5. initialization of the on-street and off-street digital parking management pilot program and wayfinding
6. initialization of the CCD mobility pilot programs (CCD MoD, CCD car sharing)
. enhancement of the connectivity at the DUIS scale (external CCD MoD stations, CCD Limousine)

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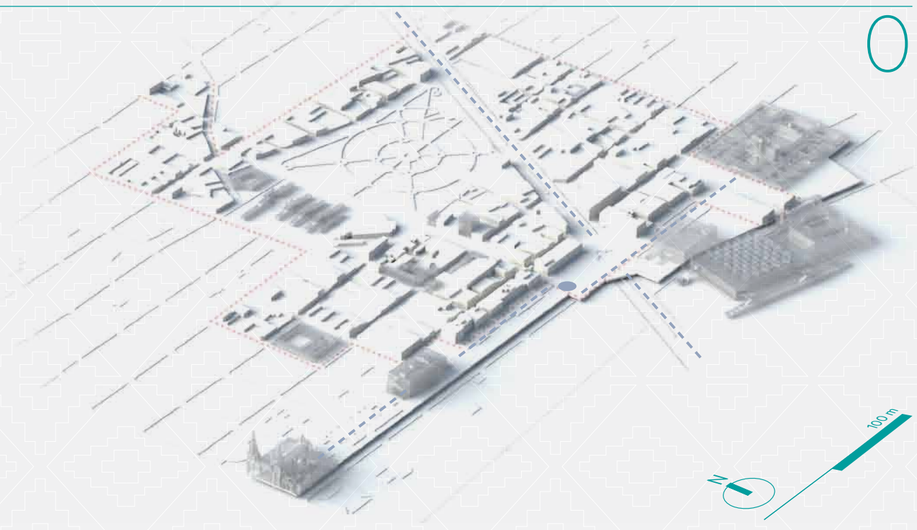


17.1.

The wider picture: mobility at city scale

17.1.1. The city road network

THE RING ROAD SYSTEM

The wide scale road network of the Area Metropolitana de Guadalajara is characterized by the presence of the Carretera Federal 15D that runs directly through the city. The clear intercity role of this connector rises the vehicular throughput across densely urbanized areas, therefore potentially directly feeding some of the most central east-west traffic corridors of the city, such as the Hidalgo/ Juarez system.

Partially related to the orthogonal grid structure of the road network, Guadalajara only has an external ring road - the Anillo Periférico - which is not completed on its south eastern part. Given the large radius of this infrastructure that is approximately of 10 km, it cannot satisfy most of the urban east-west movements due to the increase of the rout's length.

The other two more internal orbital systems are characterized by other weakness. The Avenida de la Patria is definitely characterized by an infrastructure with an express vocation, with split level junctions especially in the north-west stretch. Nevertheless, it only covers the western part of town, therefore not providing an efficient alternative connection with respect crossing the city centre. Lastly, the system composed by the Avenida Adolfo Lopez Mateos/Circular Norte/Avenida San Rafael/Lazaro Cardenas/Lapislazuli, while geographically suggesting a unified orbital path, is in reality fragmented from a functional standpoint and it is composed by several stretches of urban connectors that don't provide the required continuity to the orbital flow.

As a consequence, the overall road network at the urban scale relies on the Anillo Periférico and on a series of primary road axes heading north-south and east-west, that create a fairly regular grid of heavy traffic corridors directly fed by the Anillo Perférico and its vehicular access points from the extra-urban network. This very same pattern also re-links to the secondary network and, especially towards the centre, to the diffused road network too.

The absence of an efficient ring road system drives through traffic and high volumes across the city centre and along main vehicular corridors.

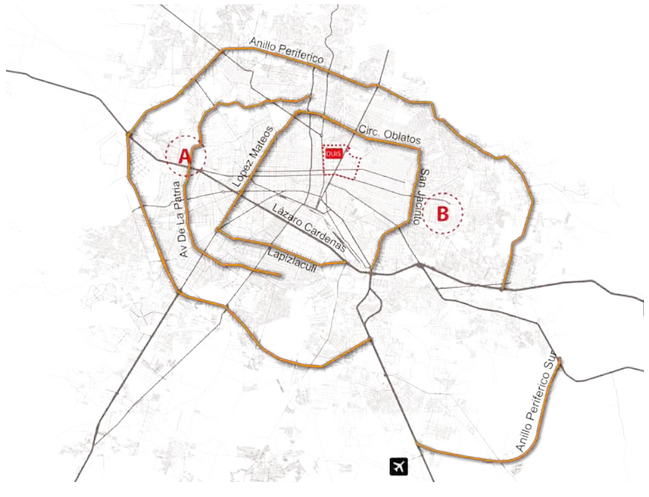
A RICH LITERATURE

In very recent years, a number of detailed mobility studies have been developed both for the Guadalajara metropolitan and central areas, generating as a consequence an extremely detailed, comprehensive and solid picture of the future planning guidelines and proposals for the wide scale private and public transport.

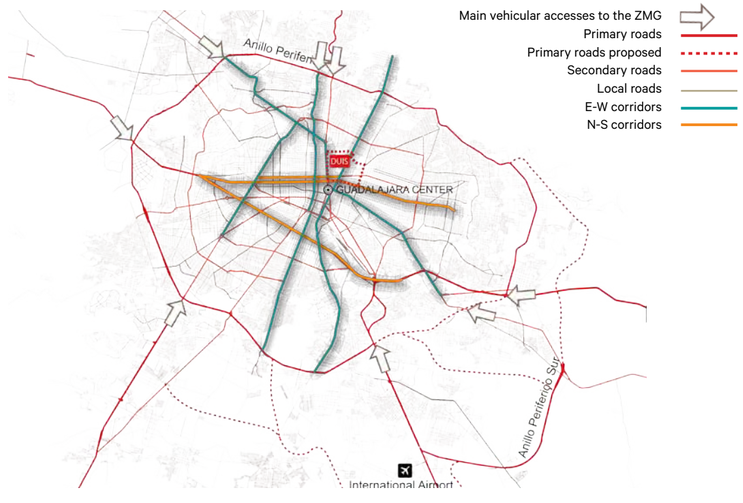
Nevertheless, no projects to implement in the long term a consistent ring road system for the city have been detailed. Hence the necessity of defining alternative strategies and solutions that could achieve similar results.
In order to define a meaningful proposal, several documents have been used as reference to set the bases for the present analysis.

Among them:
Estudio de Movilidad y Accesibilidad Urbana para el DUIS, 2012 - EPS
Estudio de Demanda Multimodal de Desplazamientos de la ZMG, 2007 - JAL
Programa Sectorial y Especial de Movilidad, 2011 - JAL
Plan de Movilidad Urbana No Motorizada del AMG, JAL

Guadalajara's motorway and primary road network



Guadalajara's partial ring road system



Guadalajara's main traffic corridors

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17.1.2. Wide scale strategies

As highlighted, the structure of the urban road network forces traffic to overload some E-W corridors, most of which run through the city centre, causing vehicular congestion. This condition is clearly to the detriment of the accessibility and circulation of the whole city and in particular of its central area.
Addressing this major issue will be necessary not only in the frame of the Ciudad Creativa Digital, but in general in order to improve the wide scale mobility of the metropolitan area. Transport and mobility planning at a urban scale involve the whole city network and transport systems considered as a whole, therefore requiring very specific studies in order to retrieve the necessary quantitative and qualitative informations on the trips' patterns. Nevertheless, it is possible to envisage some general guidelines for the urban scale in order to optimize the overall mobility through the application of access and public transport strategies.
The main target is of course that of relieving the road network from congestion and, given the Guadalajara traffic conditions, this mainly means reducing the through traffic across the city centre. Acheiving this would, as as very first result, improve the east-west connectivity at the city scale, therefore also providing a higher accessibility level to the city centre and the CCD area. At such scale and given the consolidated urban context, the traffic reduction can only be obtained by shifting trips from the private vehicle to the public transport by providing a real alternative to the car and making it appealing and convenient for the user. Probably the most efficient - because direct - way of achieving this is the application of access and circulation strategies at the city scale that discourage the use of the car.

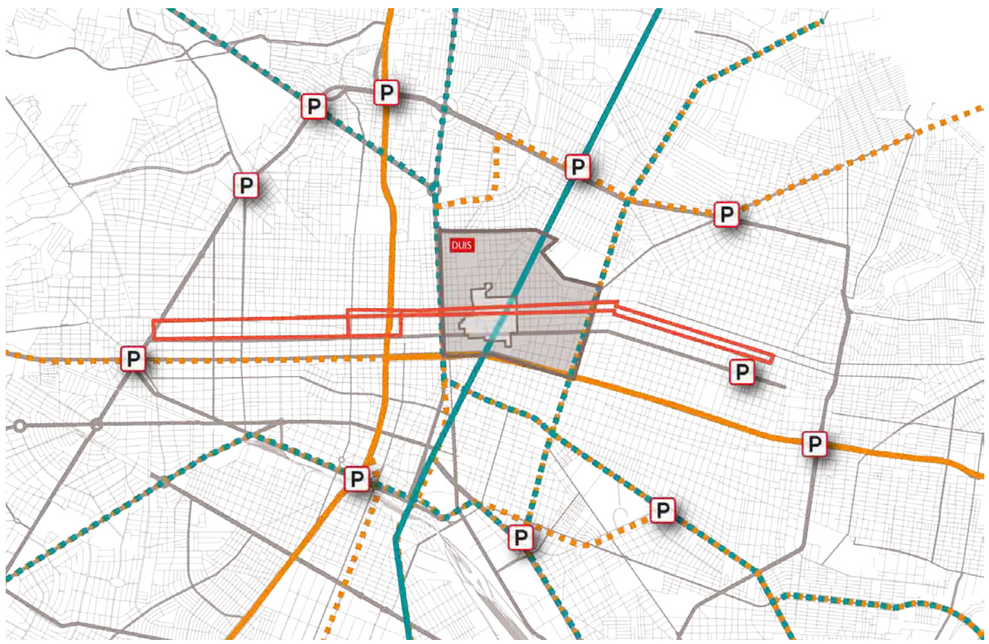
ROAD PRICING, PARKING STRATEGY AND ROAD INFRASTRUCTURE DOWNGRADE

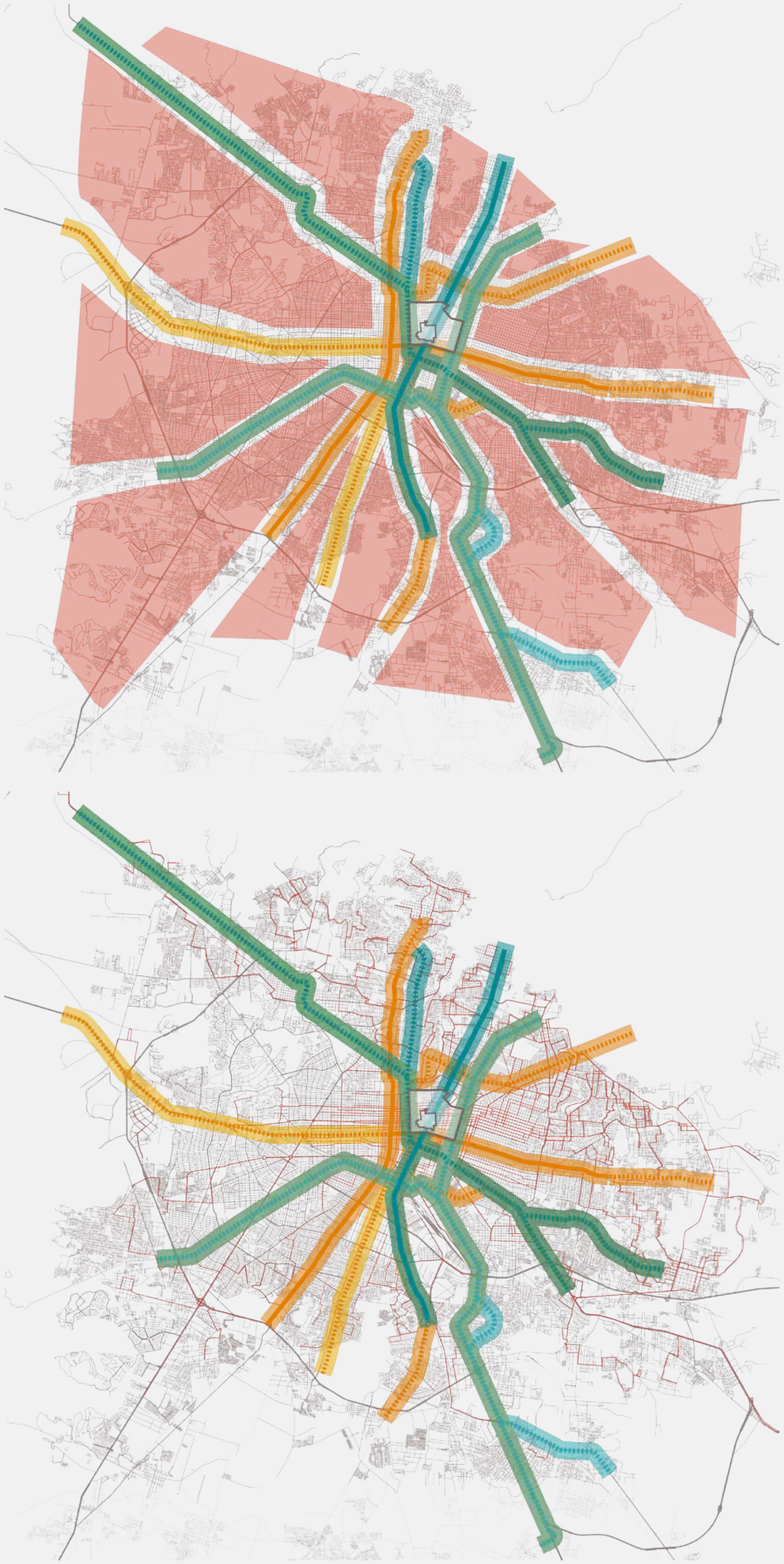
One of the two options here considered is the implementation of a road pricing system. This could be though of as a gradient defining the fee on the base of the proximity to the city centre. The introduction of a congestion charge has generally a very notable effect in the very first period, while on the medium term it will then rely on a average reduction of 10% to 15% of the original flow. The through traffic that originally passes through the city centre, tends to redistribute on the secondary and local network, diffusing across the urban grid instead of concentrating on few main axes.
Another possibility relies in the tuning of the parking strategy at the urban scale. There are several new possibilities for the definition of the parking provision at the city scale that have already been implement in many cities around the world and which are oriented to a more innovative and sustainable approach to mobility. It is widely recognized how the availability of parking at destination is one of the most powerful drivers for the mode of transport choice. Setting maximum limits to the parking rates related to a specific land use instead of minimum ones, pushing for the unbundling of the car park provision from the specific function so to promote policies for car park sharing, implementing parking pricing strategies that can also take advantage of the real time information becoming dynamic and adaptive tot he actual demand, all these are options that can efficiently be applied. Moreover, the implementation of an efficient interchange car park system for Guadalajara that works in synergy with the high capacity transit is here explored in grater detail. The parking facilities should be located in correspondence of intersection points between the primary road infrastructure and the high capacity public transport systems. This configuration would allow an efficient trip solution for the user who will tend to leave his car at the car park. Of course pricing and distance from the final destination (the centre) are other two fundamental elements for the successful implementation of the strategy: the distance of the parking ring should in fact be big enough so to not be perceived by the user a short drive away.
In case specific areas withing the interchange car park ring require some dedicated parking facilities or the presence of an on-site provision, then the fee imposed should be carefully tuned in relation to the wider system's pricing, in order to avoid the creation of a more convenient alternative that would make the vehicular penetration more appealing.
An action that can also be intended as a corollary of these wide scale strategies, is the downgrading of the road infrastructure in the most urbanized areas: by changing the originally express vocation of the considered road or junction to a urban and pedestrian friendly shape, a natural re-distribution of the traffic patterns could be achieved. This approach can be applied with more or less radical interventions, that could range from a simple retrofitting to a more substantial modification of the infrastructure layout.

Wide scale access and parking strategies such as **an interchange car park system would help reducing congestion,** therefore improving circulation and accessibility to the city centre.

Wide scale strategies: congestion charge and interchange car park sity system

Proposed interchange car park system for Guadalajara





up, areas unserved by the existing and planned high capacity transit systems; down, the potential coverage provided by the local bus network

HIGH CAPACITY PUBLIC TRANSPORT SYSTEMS

The second planning instrument in the hands of the Municipality and of the Government that could play a role in shifting people to the public transport is of course the enhancement of the Guadalajara transit system.

As said, the planning framework at the urban scale is already highly developed, and the actual implementation of the proposed scenario would already be a major improvement in the city mobility frame. Nowadays both existing lines of the Tren Ligero serve the DUIS area improving the overall accessibility on public transport. Nevertheless, line 1 layout doesn't allow a direct accessibility to the area, requiring a further level of connectivity. The future planned lines would certainly improve the situation, especially thanks to the line 3, A and D. Nevertheless, it should be considered that these latest lines are planned in a long term scenario and won't therefore be an immediate solution. The existing BRT line 1 insure a very high level of accessibility by public transport to the site area, getting right to the heart of Parque Morelos. Moreover the medium term expansion plan would improve the N-S connectivity at the urban scale, reducing the pressure on Alcalde, and the long term scenario will include a potential corridor towards the airport.

Another point of strength of the overall high capacity systems plan is the possibility of implementing some of the future BRT lines as a initial phasing of the forthcoming LRT lines in case their implementation witness any delay.

All this considered, the images to the right highlight the area coverage at the city scale of all existing and planned high capacity systems, considering a buffer of 350m radius from the transit stops. This distance is to be considered as a representation of a comfortable pedestrian accessibility condition for a system of the hierarchy of the Macrobus or Tren Ligero.

It can be noticed how, despite the balanced overall distribution of the public transport routes across the urban area, the actual pedestrian coverage of the system is fairly limited and doesn't provide any service in many of the areas located in between the transport lines. This comment applies to both the eastern and western part of town, but it is more evident towards Zapopan and Minerva, which are incidentally also areas with a particular high potential with regards to the CCD master plan.

In particular with regards to the BRT line, a valid approach on order to improve its coverage at a urban scale would be that of guaranteeing the efficiency of the existing and potentially proposed feeder bus lines through the implementation of dedicated lanes. This would preserve the respect of the timetables and could improve the connections and waiting times at the BRT interchange stations.

Despite the balanced overall distribution of the high capacity public transport routes across the urban area, the actual pedestrian coverage of the system doesn't provide any service in many of the areas in between the transport lines.

ENHANCING THE LOCAL PUBLIC TRANSPORT SYSTEM

Guadalajara has an extensive network of local busses, which is currently managed by several different private providers. As a general consequence and despite the capillarity of the service, the density and distribution of the city bus routes produces an over dimensioned transit offer along specific corridors of the city centre, to the detriment of the system's efficiency. In order to exploit the market demand, nearly 70% of the overall routes passes through the centre, and most of them start and end in the peripheral part of the city, producing long and non optimized routes' configurations. Nevertheless, the solution proposed in order to support the existing and planned high capacity transit system precisely relies on the enhancement of the efficiency of the local public transport, since only achieving this goal enables the creation of an efficient multimodal approach, based on the synergy among all the available transit offer.

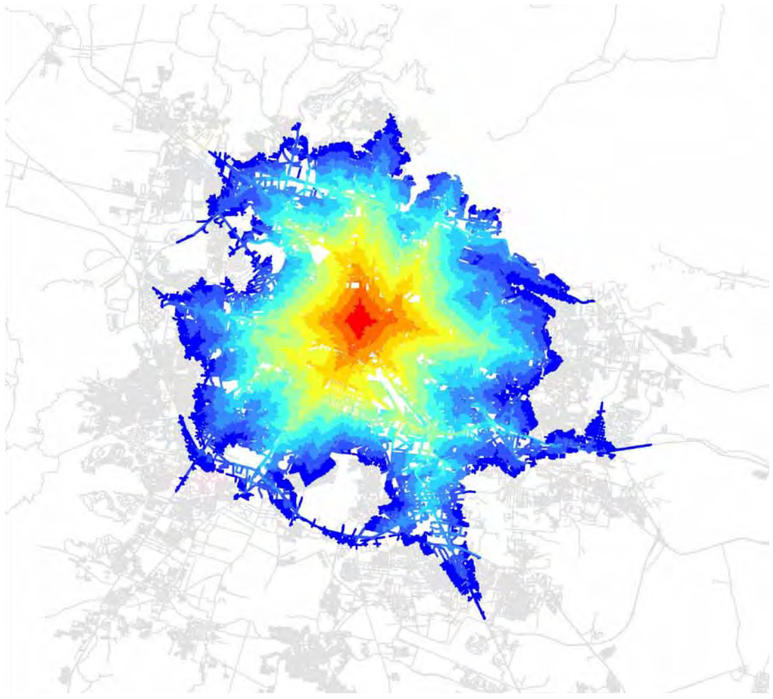
The coordination and redistribution of the routes, based of course on the knowledge of the transit demand at a city scale, would of course be the first intervention required. Nevertheless, there are other several interventions that can be implemented in order to optimize the system, which are more related to the infrastructure instead of to the providers. the solution that would have immediate effect on the service's quality would be the implementation of dedicated bus lanes. Separating in fact the bus route from the interference of the vehicular traffic will increase the fleet's speed, regularity and efficiency. The creation of a number of dedicated lanes throughout the city would of course reduce the capacity of the involved links. A verification of the city scale traffic model will have to be associated to this type of road network's modifications.

A further blend of this approach can also take into account - if more efficient from a flow redistribution standpoint - the proposal of bus-only streets, especially considering the mostly one way configuration of the road network. Considering as a general rule that "the more segregated the lane, the more efficient the system", the interaction with the car movements still happens of course at the junctions. Hence the synchronization of the traffic lights rises spontaneously as the second aspect of the process, in order to create a proper transit corridor that gives priority to the buses' transit. Lastly, pricing measures as the described road pricing, as well as incentives for the public transport users can complete the frame of a transit oriented city policy.

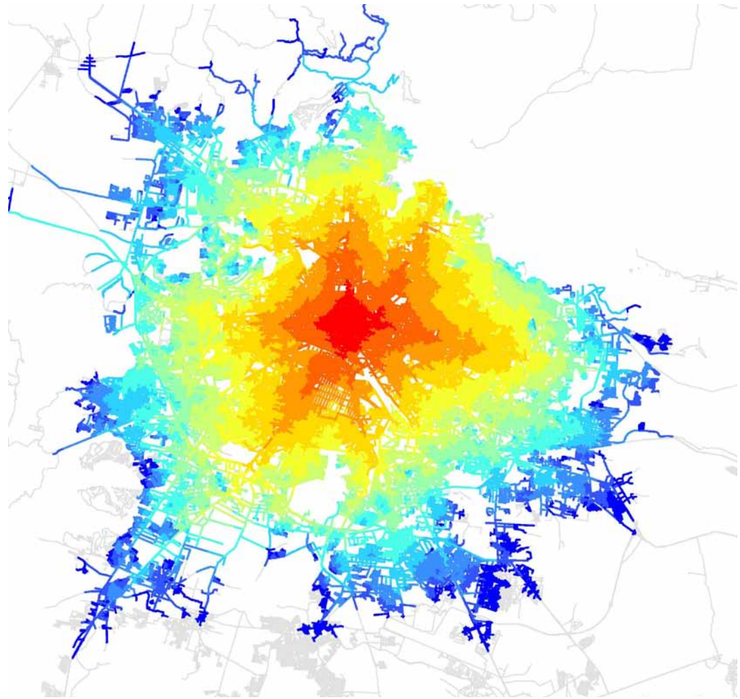
Considering the city scale isochrone accessibility analysis reported in these pages, it can be assumed that the representation of the peak hour map for the private transport also basically represents the same information for the movements on the public transport using the local bus systems. These are in fact currently running on promiscuous roads, where they are penalized by the traffic congestion phenomena that force them to move at the same speed of the private vehicles. The second map represents the situation as if 50% of the local bus routes was running on dedicated lanes. The clear expansion of the coverage in this latter example finds another representation in the deformed grid that shows how the space would virtually shrink as a consequence of the shorter trips' duration.

The enhancement of the local public transport, primarily through the introduction of dedicated bus lanes, **will support the Guadalajara's high capacity transit system** in the frame of the creation of a solid and efficient multimodal transport system.

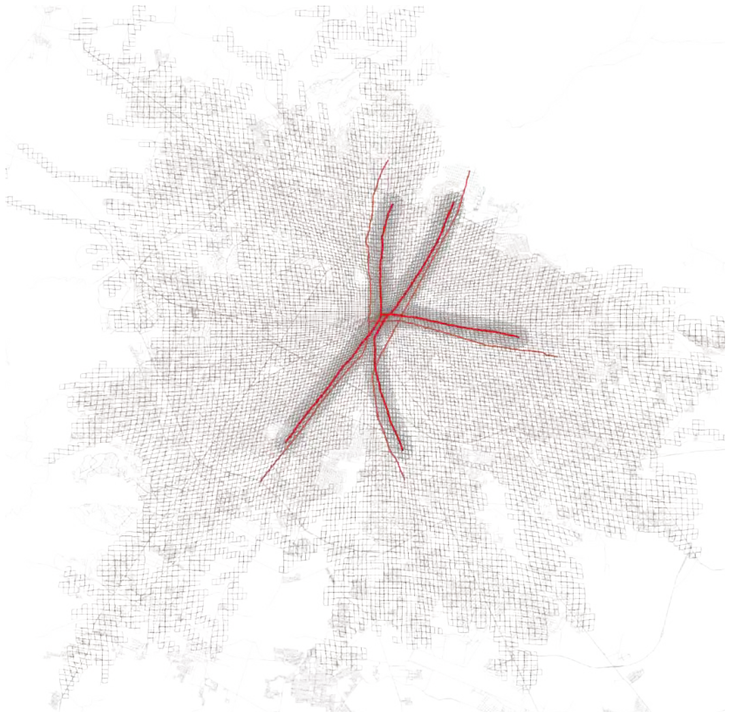
Current situation: private transport PH isochrone analysis considering no bus routes on dedicated lanes



Proposal: Public transport PH isochrone analysis considering 50% of the bus routes on dedicated lanes



Current situation: private transport PH isochrone analysis considering no bus routes on dedicated lanes



17.1.3. Best cases international catalogue

As already shown in previous sections, the strategies to improve urban accessibility can be many. The following list shows some hints of case studies that have stood out for their effectiveness or for their brilliant and innovative alternative. We can divide these samples into two main categories: the examples of a good enhanced public transport, such as Curitiba, Zurich or London, which work on different scales in different ways, but all of them contribute to the improvement of the public transport network and accessibility of urban space; and examples mainly working on Discouraging car usage at two different levels, using various Parking strategies or applying Road pricing.

The enhanced public transport examples, especially Curitiba and Guangzhou, find their strength in their multimodal approach: the fast connections, the facilitated exchanges and the integration of different types of transport within the same network, allows the user to benefit from a larger and more wide-ranging system, which facilitates the commuting and fills in the gaps of the networks of rapid transit with a more extensive network of local districts services. Other examples of the same category, such as London, show how to work primarily on dedicated lanes to reduce urban traffic can give immediate and satisfactory results. Other cases, such as Zurich, impress for their data on modal share, which denote how the most of the population chooses to travel with public transport, inevitably qualifying the system as successful.

Another interesting case is undoubtedly Barcelona: the orthogonal grid of the city, not dissimilar to Guadalajara's, makes this example very useful for an hypothetical application of these policies to Guadalajara's urban fabric. Here, too, it is a winning case since it leads the field in the latest generation of digital tools (for the benefit of both users and the operator), together with a new network of vehicles that integrates with the existing one and creeps precisely in the urban fabric using different levels of connection.

Concerning the parking strategies and the road pricing, several cases shown in the Catalogue witness how the quality of life in urban environments is inversely proportional to the number of vehicles within the urban area. Return the space to pedestrians and cyclists becomes the first aim to be pursued in a contemporary age where cars and pollution are finally identified as the cause of what can be called "urban uneasiness". After many steps toward a wrong image of the future, toward a wrong idea of progress, studying people in urban contests indeed shows the need society has to go back to simple and collective life. Once the era of individualism and waste is ending, mobility strategies on public transport can and should be a resource to be exploited to improve the quality of life in the city. The closure of many centers to car traffic clearly shows that this can be achieved. Supporting these actions with an adequate public transport service may be the solution; observing the results of cities that already experience these strategies and then working to improve them becomes essential.

The Best cases catalogue shows international examples of best practice and good strategies to improve mobility in cities at urban scale..

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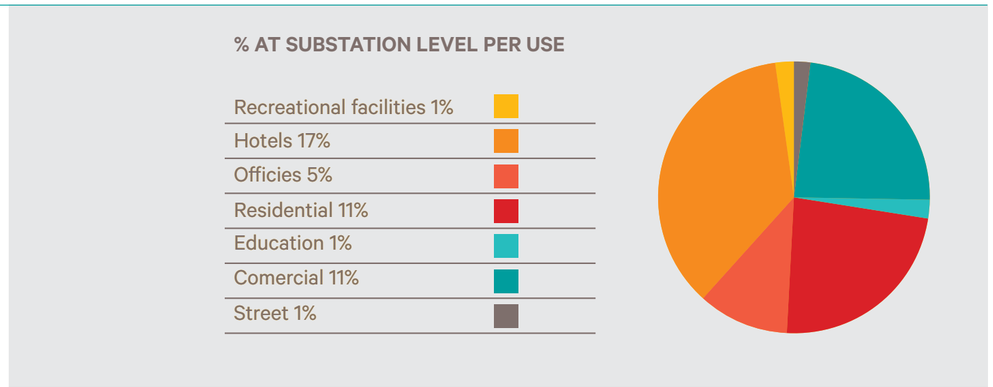
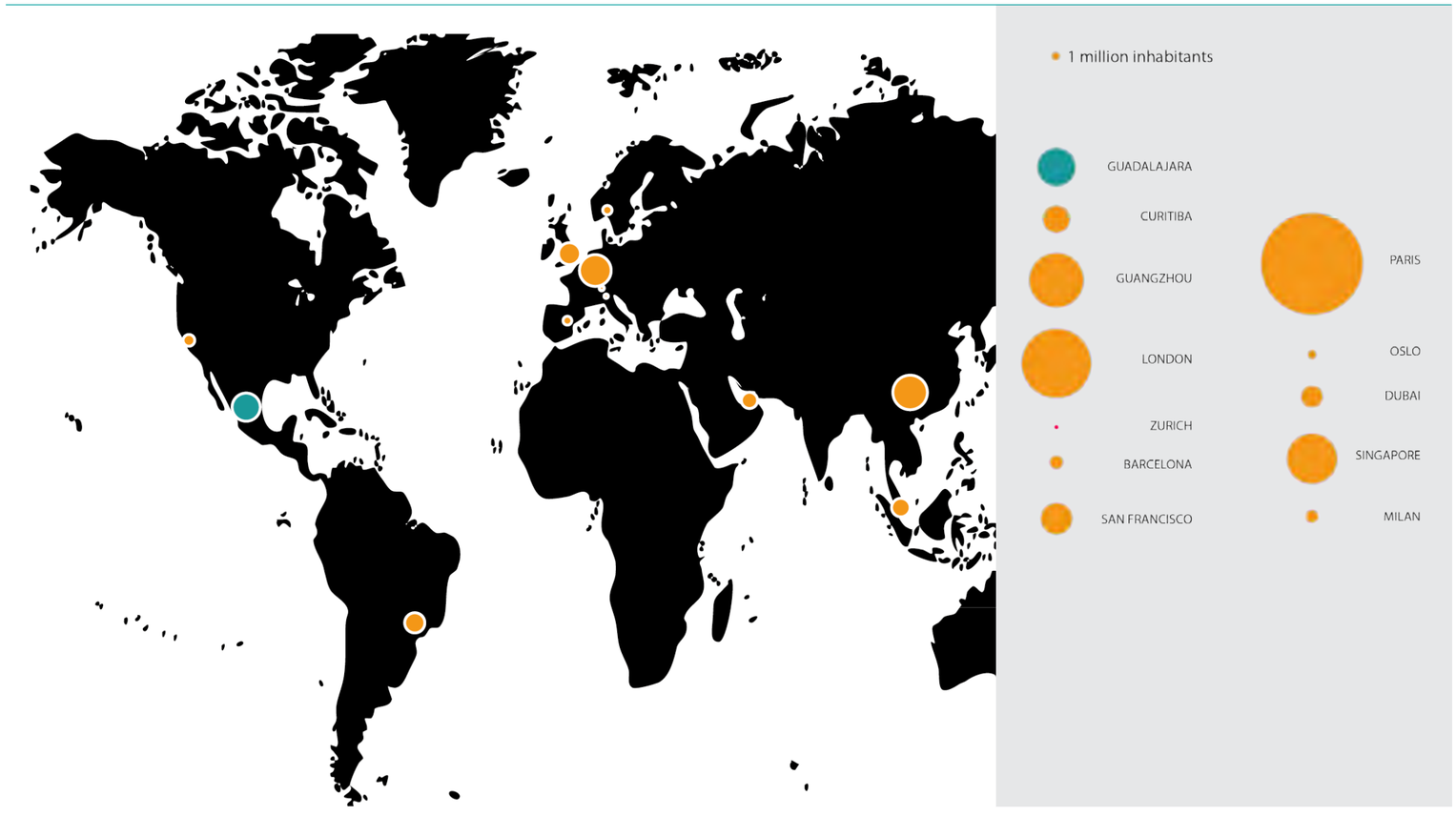
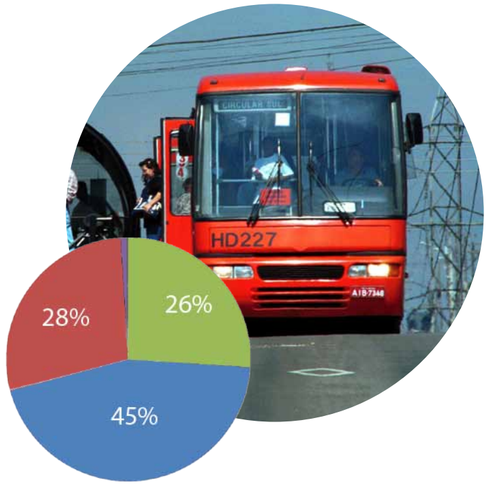
Modal share

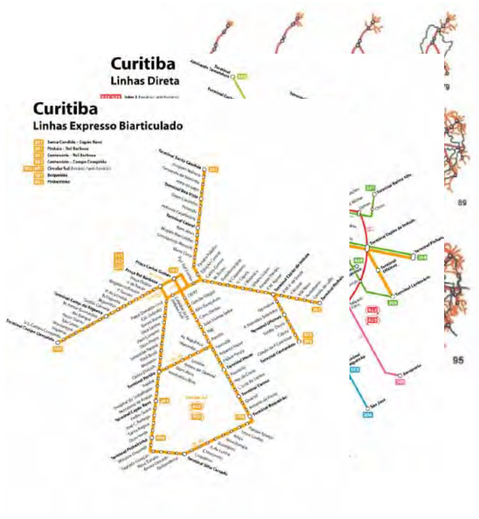
analysis of main cases of enhanced PT system:





Enhancing Public Transport



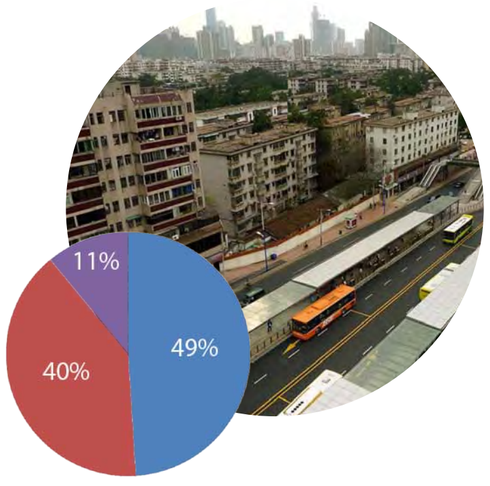


Curitiba, Brazil

3.2 million inhabitants, 1540 km²

The "Rede Integrada de Transporte" (RIT, Integrated Transport Network) is an example of a good public transport system established from 1980 through the years together with a orecise land-use planning.

- 7 express BRT lines + 19 direct lines
- 350 total lines through 13 municipalities
- 81 km of dedicated lanes; 21 transit centers
- 2.3 Million Passengers a Day (85% of the population)



Guangzhou, China

6.3 million inhabitants, 1160 km²

BRT network well integrated with the slow mobility system. Guangzhou won 2011 ITDP Sustainable Transport Award for Bus Rapid Transit System in China, beating Tehran and Lima thanks to a successful and highly popular bus rapid transit system hat integrates with wide, tree-lined bike lanes, a bike share program, and metro stations.

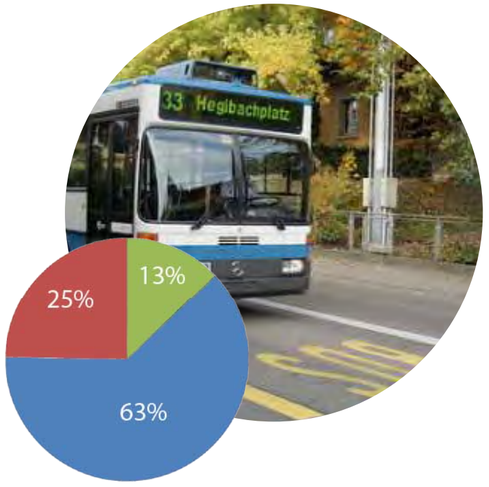
- 800.000 Passengers a Day / 27.000 per Hour
- the longest BRT stations ion the world (260mt long)

London, United Kingdom

8 million inhabitants, 1570 km²

Increase of the local PT system efficincy with dedicated lanes.

As an example of active users' interface, London owns an heterogeneous system which keeps the network dynamic: Bus Lanes aren't just for buses. Taxis, motorcyclists and cyclists can use them most of the time too.

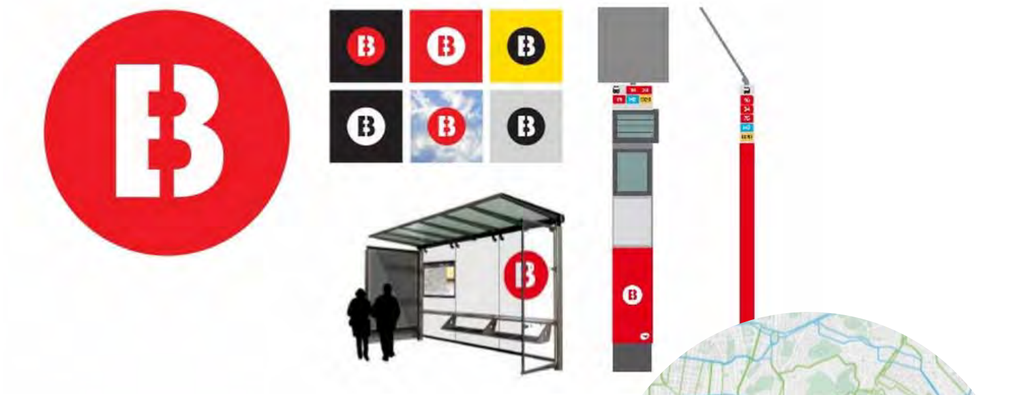


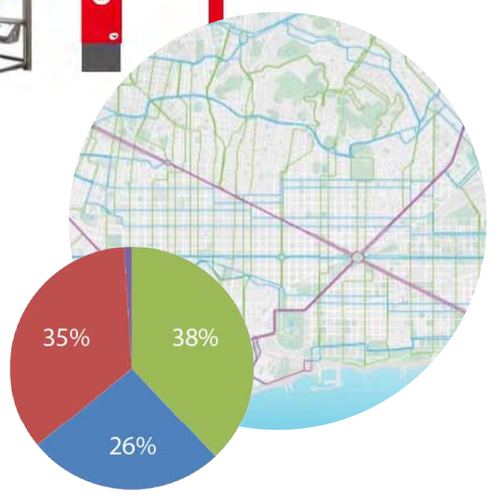
Zürich, Switzerland

386'000 inhabitants, 90 km²

Increase of the local PT system efficiency with dedicated lanes.

The introduction of segregated tram and trolley routes, as well as of bus lanes and bus-only access to pedestrianised areas, plus the setting up of computerised operational control systems and selective vehicle detection at 80% of the traffic signals on bus and tram routes, have enabled public transport patronage to remain buoyant. The Zürich transport policy is an outstanding example of a sustainable approach.





Barcelona, Spain

1.6 million inhabitants, 100 km²

Barcelona's orthogonal city structure resembles Guadalajara's. The Municipalities new project for the implementation of the Public Transport network suggests new solutions for the mexican case. The project took asvantage of the configuration of the city the new model of the city, the multimodal reality of new public transport systems.

28 new lines have been added to the network:
- 17 vertical lines
- 8 horizontal lines
- 3 diagonal, as radial

Discouraging Car Usage,
Parking Strategies

London, United Kingdom
Absence of parkings or high fares for parkings in central areas.

The Mayor, in conjunction with boroughs, will seek to ensure that on-site car parking at new developments is the minimum necessary and that there is no over-provision that could undermine the use of more sustainable non-car modes. The only exception to this approach will be to ensure that developments are accessible for disabled people.

San Francisco, California
Absence of parkings or high fares for parkings in central areas.

Improvement of the parking system through technological innovation and data collection: sensors at each of the 6,000 parking spaces collect real-time occupancy information, that modifies the parking fee and helps drivers finding available parking.

Paris, France
10.4 million inhabitants in the Urban Area

Regulation doesn't set ratios, supply is driven by the market.

Paris' parking policy has recently been redesigned to discourage car use. From 2003 to 2008, 25'000 on-street parking spots have being eliminated and 95% of on-street free parking spots remaining have been converted to paid parking spaces.
The city's goal is to make it easy and affordable to park in Parisians' home neighborhoods (75 cents a day), but very expensive and difficult to park in other areas (up to $4 dollars an hour).

Zürich, Switzerland

The essence of Zurich's historic compromise of 1996 was that parking in the core of the city would be capped at the 1990 level, and that any new parking to be built would, on a one-to-one basis, replace the surface parking that blighted most squares in the city at the time. Today, almost all these squares are free of parking and have been converted to tranquil or convivial places for people to enjoy. In 1989, the city turned this regulation on its head by adding parking maximums to their code, and in 1996, the parking maximums were adjusted to make them even more restrictive.

Discouraging Car Usage,
Road Pricing

London, United Kingdom
The "Congestion Charge" introduced in 2003, operating within the Congestion Charge Zone (CCZ) in central London, remains one of the largest congestion zones in the world. The charge aims to reduce congestion, and to raise investment funds for London's transport system.

Dubai, United Arab Emirates

Is the first road-charging scheme in the Middle East. Dubai Roads & Transport Authority (RTA) estimated the charges reduced traffic by around 25%, which at 97,500 vehicles per day netted the Dubai government Dhs142.4 million ($47.4 million) per year.

Oslo, Norway

The Oslo electronic road toll system was launched in 1990. The background reason was the increasing road congestion during the 1980´s; the purpose of the toll system was to finance new investments, that otherwise would take too long to realize.

Singapore

Already in 1975 Singapore implemented a type of area-based system, which is considered to be the first modern road pricing system in the world. In the fall of 1998 it was made a totally automatic system, the ERP system (Electronic Road Pricing System). The background for implementing road pricing was the high exploitation of land and rather high standard of living, and these factors made traffic restrictions necessary.

Milan, Italy

Area C is a congestion charge introduced in Milan, Italy, on January 2012, applied on the central traffic restricted zone, which encompasses about 8.2 km2 and 77,000 residents (4.5% and 6% of the city total, respectively). The area is accessible through 43 gates, monitored by video cameras.Area C is as an 18-month pilot program based on the partial implementation of the results of a referendum that took place on June 2011. The aim of the program is to drastically reduce the chronic traffic jams that take place in the city of Milan, to promote sustainable mobility and public transport, and to decrease the existing levels of smog that have become unsustainable from the point of view of public health.

17.1.4
Specific criticalities

The general comments discussed in paragraph 16.1.2 are here applied to some specific relations at the urban scale that are particularly important for the future Ciudad Creativa Digital master plan. It has been in fact noticed that it is fundamental to set the basis for implementing a capillary connectivity with the centre throughout the whole city, and both the eastern and the western part of town have a great potential for their future relation with the CCD. Nevertheless, in these pages the focus is on the connections to the west side of Guadalajara, due to the extensive areas potentially uncovered from a public transport standpoint and to the characteristics of these residential and highly populated zones.

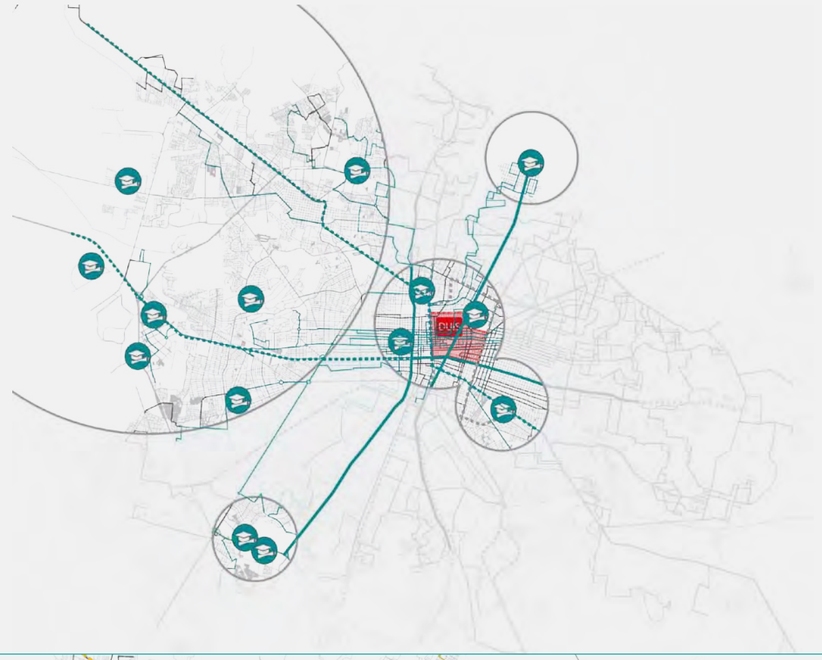
LA MINERVA AND THE WEST SIDE

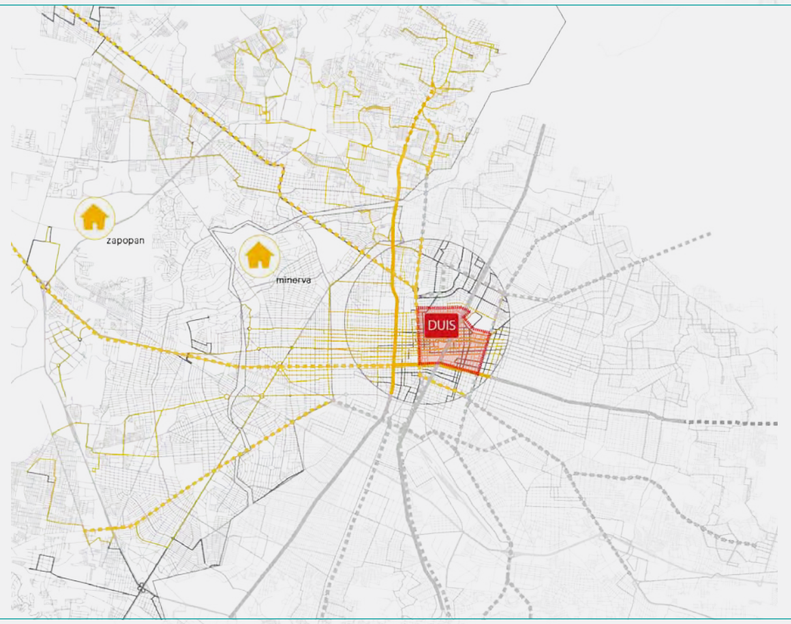
The western municipality of Zapopan is the second for population in the Zona Metropolitana as well as in the whole Jalisco state, and it is also the one with the highest GDP per capita in the Jalisco area. These characteristics make it of course a preferred target for establishing fruitful relations with the CCD from the very early stages: commuters, customers or investors of the Ciudad Creativa Digital could be based in the West side of town. Moreover, the Minerva, the western part of Guadalajara's Municipality towards Zapopan, is another important area that for its past as virtual town centre still covers an important role in the city dynamics.
As preliminarily discussed, the West town is currently underserved from a public transport standpoint, especially considering the low efficiency of the existing bus service. Another fundamental aspect to evaluate when considering the master plan's connectivity is the well known university vocation of Guadalajara. First established in the XVIII century, the University of Guadalajara, along with a good number of private universities, guarantees a lively academic environment in which the CCD and the institutional part of it will find a fertile ground. All this considered, the vast majortiy of these academic entities is located in the above mentioned west part of town, therefore having to cope with the mobility frame envisaged for the area. Most of the university areas across the city are connected through high capacity, fast systems to the future CCD site. Nevertheless many universities located in the Zapopan area will only be reached by mid to long term transit plans.

Zapopan and La Minerva can become preferred target for establishing fruitful relations with the CCD from the very early stages. Hence the will of specific solutions to enhance the east-west connectivity at urban scale.

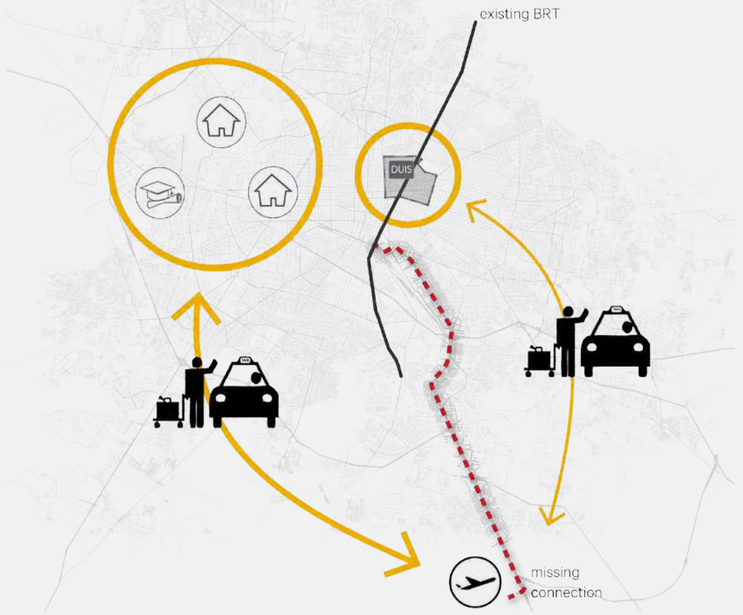
THE AIRPORT

The Guadalajara International Airport, also known as Miguel Hidalgo y Costilla International Airport, is located 20 km south of the city centre of Guadalajara, on the route to Chapala. Despite being Mexico's third busiest airport, there is currently no public transport connection available towards the city centre and even the currently long term planned BRT lines will allow to reach the CCD with 2 changes. At today, the air routes cover nearly 20 domestic destinations as well as more than 10 destinations in the United States. In the frame of the creation of the future digital hub, the importance of having a direct and efficient connectivity available between the airport and the CCD is fundamental in order to satisfy and sustain the project's international vocation.





Clockwise, existing and planned transit routes conencting the city centre and respectively: Minerva and the west side of town, the city universities, the airport



17.1.5 Solutions for Guadalajara

EAST-WEST CONNECTIVITY

It has already been mentioned how the implementation of the city transit master plan would be a major and important step towards the improvement of the overall city connectivity. Nevertheless some more specific actions are here suggested and outlined in order to strength the east-west connectivity across the city centre. As explained, this not only in order to provide the necessary accessibility level to the new development, but also as a general instrument so to reduce the private traffic in the city centre. It has already been highlighted how the role of local public transport is potentially central in solving the connectivity problems of the west part of Guadalajara. The first intervention suggested has consequently been the creation of protected transit corridors through the implementation of dedicated bus lanes. In these pages we present a summary of the main characteristics of different types of segregated transit systems and it is confirmed how the creation of a local bus network would already greatly improve the service. This thought can drive the definition of specific transit corridors that are particularly important in supporting the east-west connectivity. Among these, a first intervention should include the Pretren, which is a bus system with a great potential - also thanks to the card ticketing system already implemented - and that solves a very important function in completing the Tren Ligero Line 2. Having the Pretren on dedicated lane would improve the overall Line 2 efficiency, not only as a consequence of a higher average speed of the Pretren fleet, but also because of the possibility of defineing precise timetables and system exchange with the rail line.

Specific transit proposals to envisage solutions easy to implement and efficient in improving the CCD accessibility and connectivity towards crucial areas of town in the short term period.

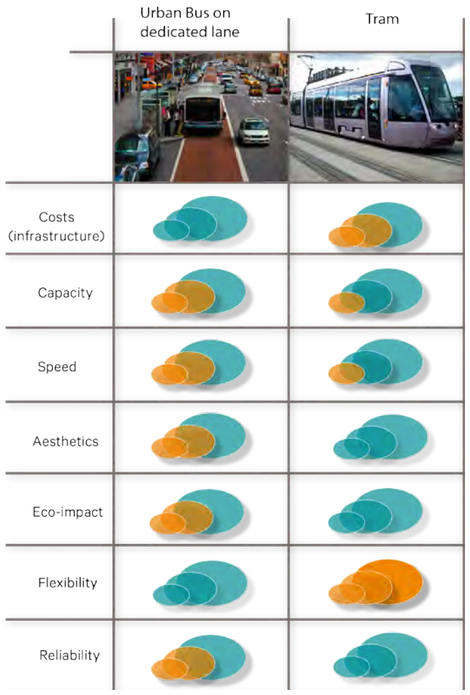
Also the existing trolleybus is a transit route that envisages a potentially efficient service between the Minerva zone, the city centre and beyond, towards La Perla and San Juan de Dios. Nevertheless, the use of a promiscuous road network force the public transport to the average - and low - speed of the congested private transport. The proposal here presented suggests to provide a dedicated lane to the trolley system, but the definition of such action would of course imply a reduction of the overall vehicular capacity on the road axes considered. Turning a normal lane into a transit only lane is equivalent in fact to remove the correspondent amount of vehicles from the capacity count. It is therefore clear the necessity of completing this type of mobility choices with wide scale analysis of the actual and forecasted transport demand, origin/destination studies and macro scale simulations. In case it won't possible to reserve a bus only lane - especially along Hidalgo, which is one of the busiest vehicular axes - then an alternative option that could be studied would be that of shifting the trolley bus route on a parallel but less congested path. Each and every of these comments could of course be applied to different types of transport system: a bus or a trolley bus on dedicated lane could be replaced by a tramway and the advantages and disadvantages of such choice are summarized in the table on the right. Among all others evaluations, the main plus of a tram line would be the very low environmental impact and therefore the iconic potential of such system for the CCD, while the great gain of implementing a bus route on dedicated lane would be the highest flexibility and adaptivity in case any change in the route will become necessary in the short term.

THE AIRPORT

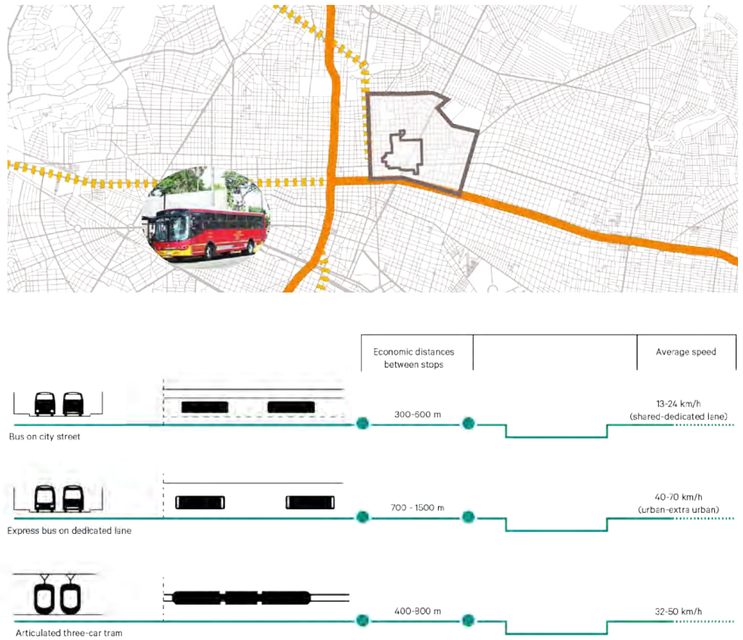
In order to provide from the very beginning the CCD with the best possible connection with the Guadalajara Internationl Airport, the following interim solutions could be implemented. Until the construction of the planned BRT infrastructure will be completed, a bus route on dedicated lane along the Avenida de la Solidaridad Iberoamericana - Emiliano Zapata - Juan de la Barrera to the Fray Angelico BRT terminal, would provide the desired efficiency in linking the airport to the BRT existing line 1. In the long term, with the implementation of the segregated BRT infrastructure, a specific *CCD Airexpress* BRT service could satisfy the mastrpln's demand, running on lines' 4,3 and 1 lanes.

Comparison between bus on dedicated lane and the tram.

LEGEND:
Green/Positive
Yellow/Negative



The pretrena and the Tren Ligero systems



Proposal for a trolley bus dedicated lane

Proposal for a potential shifting of the trolley bus route to an alternative corridor

17.2.

The DUIS and CCD: a synergic approach to mobility

17.2.1. DUIS' road network

The DUIS area is bordered by some of the city's main vehicular axes, such as the Calzada Independencia, the Hidalgo/Juárez system and Alcalde, which as discussed are mostly used by through traffic. It is also interesting to notice how the primary corridors are the ones organized in a two way regimen. Nevertheless, the orthogonal road grid produces a distribution of the vehicular flows along several other connectors, some of which are recognized as of higher hierarchy such as Manuel Acuña. Considering in particular the east-west connectivity - so crucial for the city scale movements - it is interesting to notice how, when considering the DUIS area, all of the so called *vias colectoras* or *subcolectoras* lost their continuity against the Calzada Independencia, which works as a wall fracturing the east and west parts of the DUIS. Moreover, this fracture is not only related to traffic, but also reflects in the social structure of the neighbourhoods that, despite the proximity to the city historical centre, are generally characterized by a lower urban quality. In this frame, San Diego/Esteban Alatorre is basically the only axis keeping its continuity through the Calzada, hence the current level of traffic.

When considering the DUIS area, all of the *vias colectoras* or *subcolectoras* lost their continuity against the Calzada Independencia, which works as a wall fracturing the east and west parts of the DUIS.

DUIS Vehicular accessibility and main corridors, current situation

DUIS road network | direction of flows

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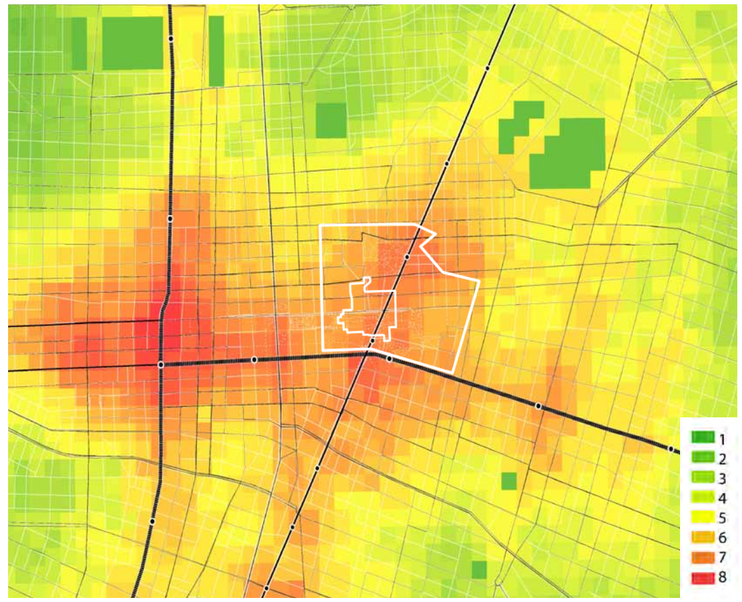
17. 2. 2
Accessibility on public transport

Considering both the existing and planned high capacity city transit, the DUIS - and the CCD within it - is located in a very favourable position. Most of the BRT and Tren Ligero lines will or currently are serving the area. It should be said that the only route that effectively crosses the DUIS is the BRT line 1, while all other systems will in reality only border it. The main consequence of this layout is that some sectors at the DUIS scale will remain uncovered by the high capacity transit systems, while the CCD, thanks to the Macrobus and the master plan scale, will always be highly accessible. This comments are graphically shown in the PTAL map here presented, where PTAL stands for Public Transport Accessibility Level. It is a method used in United Kingdom transport planning to assess the access level of geographical areas to public transport. The Public Transport Accessibility Level (PTAL) gives a synthetic measure of the access to public transport. PTAL is calculated taking in account different variables like the walking distance from any bus stop and subway station and the service level during peak times. The PTAL values range from 1 to 8. A value of 1 indicates very poor access to public transport, whereas a value of 8 indicates very good access. Thanks to the presence of the BRT and Tren Ligero nearby, the master plan area shows a good to very good accessibility level. Moreover, the maps in these pages describe the public transit coverage of the DUIS area by highlighting the pedestrian accessibility buffers to the transit stations. The buffers' radii are determined by the hierarchy and type of system. The maps refer to both primary and secondary public transport routes: the Macrobus and Tren Ligero on one side, the trolley bus and the proposed circular line on the other. With regards to the circular line, which is one of the specific interventions potentially envisaged for the DUIS project, it is important to consider that the effective functional gain related to its introduction should be evaluated against a quantitative estimation of the transit demand, as well as against an analysis of the origin/destination paths that might emerge from the desire lines and outcomes of a macro scale simulation. This is basically due to the fact that, from a transport standpoint, the functional role of the circular line will partially overlap with the local bus lines' role. All this said, the circle line's stops are planned so to guarantee an adequate coverage in relation to the urban context, as well as the highest potential for interchange with other public transport systems.

The PTAL map gives a synthetic measure of the access to public transport. Thanks to the presence of the BRT and Tren Ligero nearby, the master plan area and the DUIS in general shows a good to very good accessibility level.

DUIS PT strategy: existing and planned systems

DUIS PT accessibility levels based on existing PT



Primary systems' coverage

Secondary systems' revised stops and coverage

17. 2. 3
The DUIS and the CCD MoD

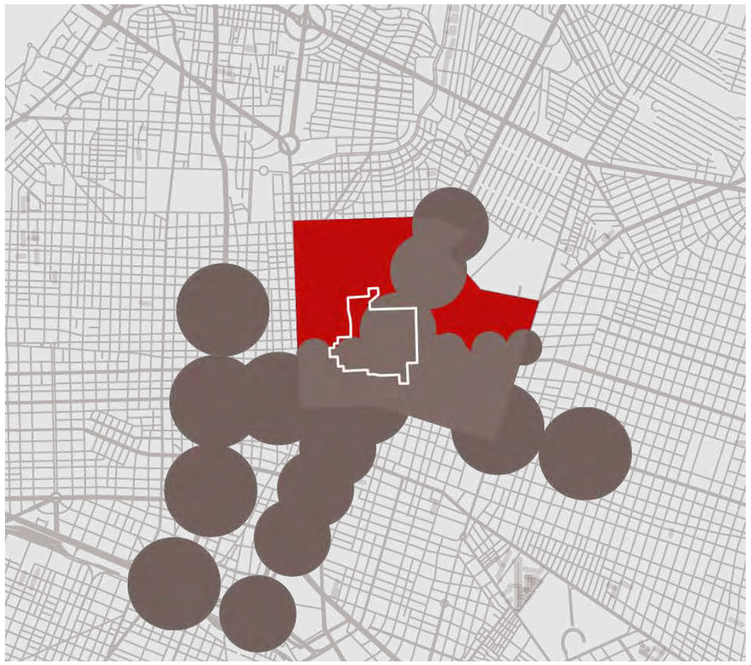
Traditional public transport is based on fixed routes and defined stops that generally provide a consistent coverage of the serviced area. Intrinsic to this structure, is the issue of covering the very initial and final portion of the trip, in particular, in getting people from a starting location to the transit hub and again from the transportation network to the users' final destination. Addressing this issue is referred to as solving the "last mile problem". This partial inefficiency of the transport chain can drive users to chose the car with the well known consequences on traffic congestion, energy consumption and air pollution in the area of the DUIS. In order to avoid this, the introduction of alternative modes of transportation that sustain the overall efficiency of the transit system is fundamental. The maps in these pages demonstrate the walking comfortable coverage in proximity of the current and proposed public transport in the DUIS and its surroundings. The primary Tren Ligero and BRT systems, which have pedestrian buffer radii between 300m and 450m, are shown in combination with the secondary systems, such as the trolley-bus, that provide a finer public transport coverage, assuming comfort buffers of 150m. Nevertheless, it is clear how some areas remain uncovered by the public transport network.

THE MOBILITY ON DEMAND

The solution envisaged to reach the uncovered areas takes into account the highly developed biking vocation of Guadalajara. While implementing, as will be shown in the next chapters, a dedicated local mobility on demand system for the master plan, the idea of re-linking to the already existing Guadalajara bike sharing network, *Bikla*, arises as a necessity. *Bikla* is a public bike sharing system with stations scattered all over town, that allows members to pick-up a bicycle in one station and drop it off in another one. The system doesn't rely on any digital platform, and the management of each and every rack is entrusted to a shop, bar or kiosk nearby. Guadalajara is a fertile ground for the biking community, and encouraging the cycling and walking culture is one of the CCD project's aims, especially considering that the urban environments are the most deeply committed to the myth of the car as an indicator of status, welfare, safety and comfort. In this frame, the CCD MoD system will protrude towards the rest of the DUIS, but at the same time the CCD will remain permeable and welcoming with regards to the city scale *Bikla* system and the bike users in general. At the wider scale, it is interesting to notice that the CCD will potentially also benefit of the implementation of several urban bike corridors, as planned in the *Plan Maestro de Movilidad Urbana No Motorizada*.

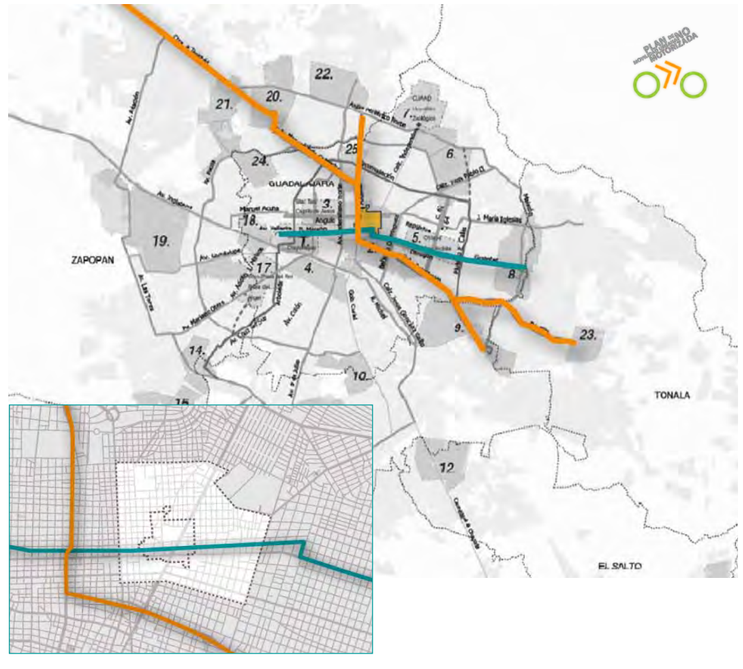
It is important to re-link to the existing city scale MoD system, *Bikla*, in order to sustain the cycling culture and maximize the multi-modal transit approach.

The last mile problem: exisitng and planned systm's coverage



Existing Ciclopuertos around the DUIS area

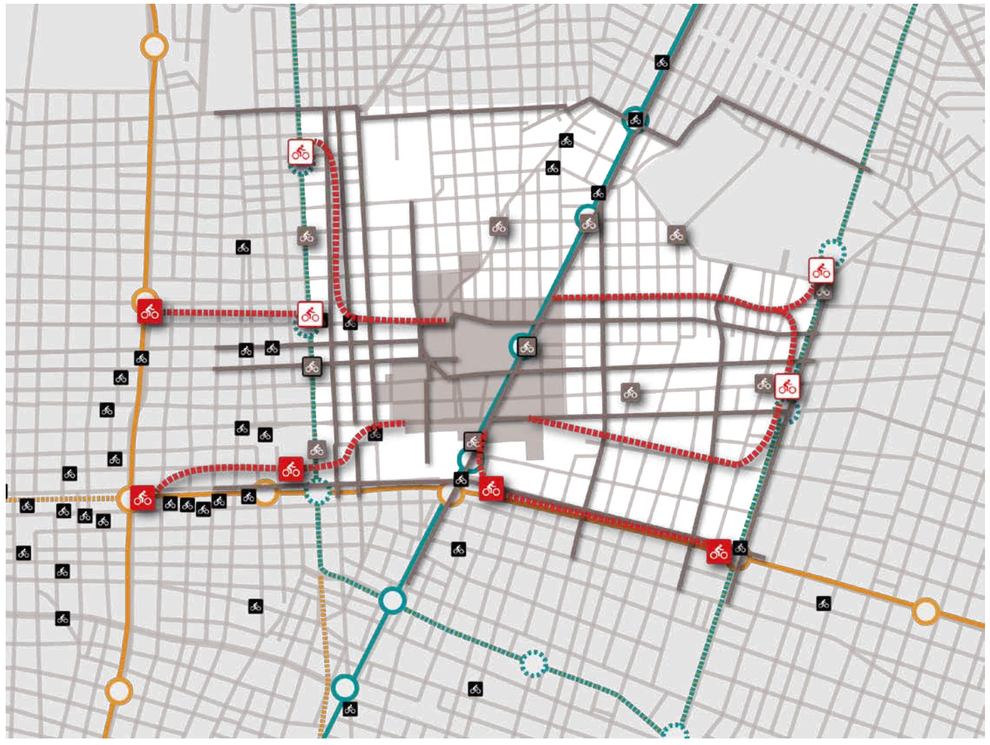
Main cycle corridors close to DUIS



In order to further sustain the public transport connectivity between the DUIS and the CCD and in the frame of supporting sustainable long range trips to the Ciudad Creative (for instance for commuting purposes), an expansion of the CCD MoD will include the primary transit systems' stops located within the DUIS but out of the CCD limits. The main goal is that of virtually expanding the buffer of influence of the CCD specific mobility on demand system, so to include in the catchment area other important transit hubs such as Plaza Universidad or Juarez Tren Ligero stops or the ones - planned or existing - along Alcalde and the Avenida del Federalisimo. This approach will also work towards promoting a pedestrian friendly and sustainable circulation across the Duis and surroundings.
As a part of the CCD Mobility on Demand system, the proposed external stations, given their primary role, can also include changing rooms, lockers, bike rental, bike repair and retail sales, giving 24/7 access to members. These stations will certainly require to redistribute the vehicles across a wider area, making the process a little more complex; moreover, they will also imply the implementation of the digital layer out of CCD. The potential difficulties related to both these two aspects will definitely be overcome by the advantages of having an easier and more direct access to the CCD from the main transit stations, as well as improving the CCD accessibility level on public transport.

The proposed CCD MoD system, while focused on the internal connections, include external stations in the proximity of the current and proposed main public transport stops, so to improve the accessibility to the master plan on public transport.

The CCD MoD, a flexible solution for the wider area



Phase 3 CCD MoD stations

Phase 1 CCD MoD stations

DUIS ciclopuertos

Red de ciclovias

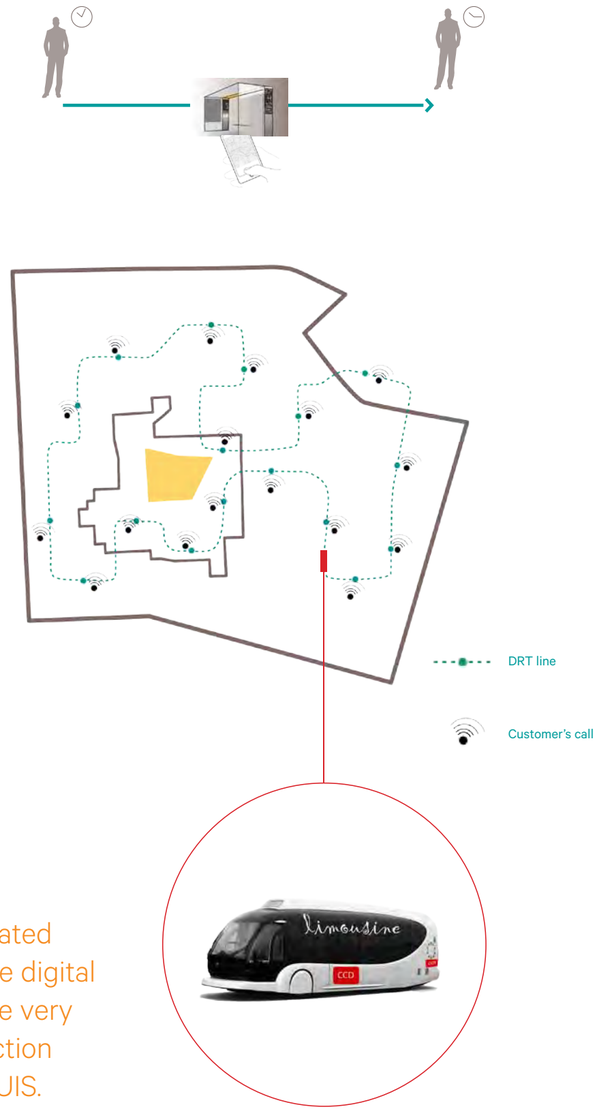
Existing ciclopuertos

Main access corridors CCD MoD

17.2.4
The CCD Limousine

In order to provide from the very first phases an iconic connection between the CCD and the DUIS, a Demand Responsive System (DRT) will be proposed. The DRT system concept was originally developed in relation to supply a subsidiary transportation service to specific groups of users, then evolving towards a more traditional transportation system, hence moving to wider groups of customers. In the frame of the CCD mobility system, the described DRT works as and enhancement of the existing transit network (hence the functional definition of Network DRT), by providing additional on-demand services. In particular, the CCD Limousine covers the specific and punctual necessities of the digital hub's users, that have to move between the DUIS and the CCD directly reaching their final destination. The CCD Limousine can be seen as a shared taxi service, that embodies the high tech and sustainability vocation of the master plan, and diffuses it across the city. The system can be based on different operational frameworks, ranging from the Zonal Flexible Route (many to few service with a flexible route within a group of predefined stops that can be booked by the user), to a Door-to Door, totally on demand system. Moreover, in order to improve the CCD Limousine service with regards to the use of the private vehicle, it will be allowed to run on public transport dedicated lane whenever available. The system is managed through a Travel Dispatch Centre that in the case of the CCD is coordinated with the digital mobility management system. The TDC plans and creates on-line flexible routes according to passengers' demand. The TDC is also responsible for trip booking, vehicles' assignment and reservation, route planning and service optimization, on-trips deviations and route modifications. Customers can communicate their own travel request through on-line booking or phone reservations. On the provider's side, an in-vehicle terminal, also equipped with an Automated Vehicle Locationing (VAL) system, provides real-time information between the driver and the TDC. The CCD Limousine can in the end also become a vector to spread the master plan vision throughout the city thanks to the use of dedicated CCD branding.

DRT Demand Responsive Transit | the CCD's Limousine



The CCD Limousine, a dedicated DRT system that relies on the digital platform, will provide from the very first phases an iconic connection between the CCD and the DUIS.

17.3.

Pedestrian mobility

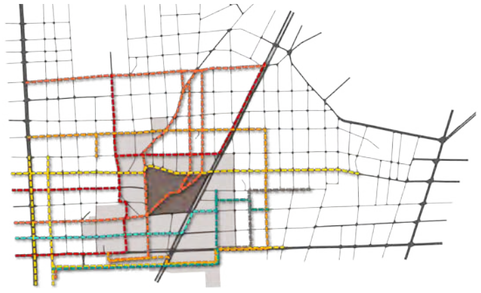
17.3.1. Site conditions and walkability

An important aspect of the CCD vision is that of a space where digital technology allows people to find their own space in every place, to create a blend between public and private, outdoor and indoor, living and working space. This incredible flexibility cannot prescind from providing the Ciudad Creativa Digital with an environment which vocation is that of comfortably host pedestrians in each and every spot of the master plan. at the same time, given the functions installed and the central location of the project with respect to the city, it is fundamental to insure a balance between the new environment's vocation and the vehicular accessibility to the area. Just denying the relation with the vehicular world would in fact be a meaningless abstraction, while guaranteeing the coexistence of all different users and types of flows is the answer to a lively and successful mobility plan for the city to come.
when speaking of pedestrian connections and accessibility, it should be considered that the distance perceived as comfortable from the people changes depending on several factors that influence the environment. Among these, very important are of course the climate conditions,that in Guadalajara are very favourable, therefore virtually expanding the radius of the comfort pedestrian buffer and ensuring that the scale of the CCD is ideal for an "easy to walk" context.
Indeed, this characteristic is at base of the strategy that will envisage basically all internal trips will happen on foot or by means of non motorized modes.
Another important assumption that must be taken into account, is the fact that the Ciudad Creativa Digital will be a place for both new residents and long time Tapatíos, and this idea also helped shaping the master plan's road network. From the outcomes of several round tables that public and private entities have been holding with the local community, some elements of the urban fabric in the Parque Morelos' surroundings emerged to be perceived as fundamental for pedestrians. Among these the Dr. Baeza Alzaga street, that borders the park to the west, has become the N-S pedestrian spine of the master plan, with a fundamental connectivity role towards the Paseo Degollado and Plaza Tapatía. Similarly, the interviews confirmed the people's interest in Juan Manuel, San Diego and Cabañas roads, which potential is enhanced by the master plan's circulation solutions. Last but not least the Parque Morelos' perimeter, currently characterized by entire sections that are perceived as dangerous, will become instead part of the core of the master plan's road network.

A balanced coexistence of all types of flows is the answer to a lively and successful mobility plan for the city to come and the scale of the CCD is ideal for an "easy to walk" context.

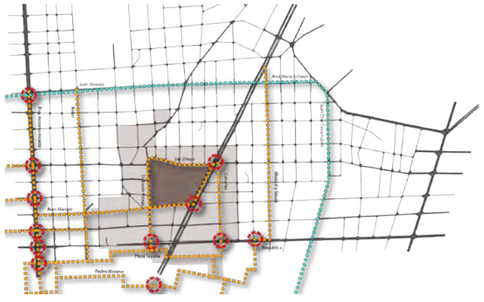
Neigbourhood pedestrian paths

source: "Gestión social para el proyecto de accesibilidad y movilidad preferencial del centro histórico de Guadalajara, 2010"



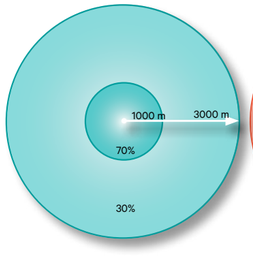
Main pedestrian routes, source "Impacto socioambiental centro GDL"

source: "Gestión social para el proyecto de accesibilidad y movilidad preferencial del centro histórico de Guadalajara, 2010"

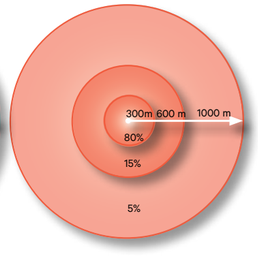


Masterplan pedestrian walking distances

Pedestrian walking distance comfortable environment



Pedestrian walking distance uncomfortable environment



17.3.2. Pedestrian vocation

The use of motor vehicles in most urban areas of the world has reached such intensity that, even in most active communities, citizens are not always aware of the extent of detriment this cause to quality of life. Given the level of awareness of its population, Guadalajara is quite an exception and the CCD project fits in the frame of keeping under control and minimizing the impact of the vehicular traffic on pedestrian life. A very interesting and still up-to-date experiment that helps quantifying - and therefore clarifying - this phenomena is the one held by professor Donal Appleyard in San Francisco. The study put in relation the community interaction and the level of communication between the buildings on te sides of the road as a function of the traffic volumes and demonstrated that people living on a street with relatively heavy traffic had only one third as many social connections as people living on a relatively light traffic street and, with the publication of Livable Streets (1981), revealed the immediate social impacts of motor traffic.
With this in mind, one of the goals of the CCD mobility strategy is the tuning of the vehicular flows along the streets as an instrument to define a strongly pedestrian oriented environment.

TRAFFIC SURVEY

In order to frame the state of the art, a traffic survey has been held along San Diego street, on an average weekday and during the morning peak hour. In particular a series of 5 minutes-long videos has been taken between 8:00 AM and 9:00 AM every 15 minutes. The practically constant number of vehicles observed during each 15 minutes interval over the period surveyed, indicates that the hourly profile had little variations. These data together and with the counting of six different vehicles' categories (car, motorcycle, bus, minibus, LGV, HGV) finally led to the calculation of the number of equivalent vehicles by the application of specific multiplication factors. The results basically confirm that the existing flow, being less than 800 veh/hour and therefore far below the nominal vehicular capacity of the road, while not compatible with a shared surface solution, still represents a potentially good environment for people and non motorized mobility, requiring improvements of the road design and pedestrian space.

Motor traffic has a direct and relevant impact on social aspects such as the number of relations and social connections between people living in the same area.

Another aspect of great importance when considering the interaction between vehicular and pedestrian flows is the cars' speed. Lower speed correspond to a higher safety for pedestrian, basically due to the shorter SSD (stopping sight distance) and to the longer time available for driver's reaction. More in general, solutions which allow for lower flow's speeds would also work for a more balanced coexistence of vehicles and people, as well as for the creation of a more urban and liveable context.

Correlation between traffic volumes and pedestrian flows
source: Donald Appleyard, 1969

Light traffic
200 vehicles per peak hour
3.0 friends per person

Moderate traffic
500 vehicles per peak hour
1.3 friends per person

Heavy traffic
1900 vehicles per peak hour
0.9 friends per person

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Traffic survey | San Diego case

718 vehicles/hour

	8:15 AM 60 veh/5min	8:35 AM 59 veh/5 min	9:00 AM 60.5 veh/5min
CAR	56	53	53
MOTO	5	/	6
MINIBUS	1	1	1
BUS	2	4	2
LIGHT GOODS VEHICLE	1	5	6
HEAVY GOODS VEHICLE	/	1	/
BICI	3	/	/
WALK	12	18	12

17.3.3 “Quick wins” and pedestrian crossings

Pedestrian permeability across a fine grained pedestrian network is the base element for a sustainable mobility approach. As a consequence the first interventions are aiming at increasing pedestrian permeability and therefore also increase pedestrian safety at junctions. A diagram of the overall number of casualties at junctions across the site highlights that some of the most important pedestrian crossing - in particular the two that currently connect to Parque Morelos across the Calzada Independencia - are currently characterized by ay fairly high number of accidents. Solving this issue with an efficient intervention is part of the master plan first phase.

THE “QUICK WINS” STRATEGY

In the frame of providing as soon as possible a context coherent with the master plan’s specificity and vocation, a set of small interventions on the road network is proposed. These would immediately increase the pedestrian quality and livability of the road network, through relatively low cost and fast to implement modifications that are, despite the little intrusive action required, of great impact. It is interesting to look at some international best case such as Zurich and Ian Gehl’s pilot project for Brodway - NY, where the changes are implemented temporarily with simple solutions in order to test the effect and have an immediate feedback from the community. Along with a general re-qualification of the curbs and pavements, a specific attention will be paid to the pedestrian crossings. The introduction of pedestrian traffic lights is the first element that will insure a safe and efficient relation between car and pedestrian flows, especially where traffic volumes are not negligeable. Another important intervention is the reduction of all curbs’ radii, since this configuration forces vehicles to slow down when approaching, immediately improving the safety of the interaction between cars and people crossing. Moreover, providing a highly visible set of road sign as well as protected pedestrian crossing are other elements that will enhance the priority given to pedestrian across the CCD. this can include the differentiation of the paving, the creation of risen pedestrian crossing that, by means of the change in level, again force cars to slow down. Last but not least, especially when considering large road sections or the presence of public transport within the road right of way, the implementation of pedestrian islands that allow people to cross with comfort even in case they have to stop in between.

Pedestrian permeability across a fine grained pedestrian network is the base element for a sustainable mobility approach. This is the aim of the “quick wins” strategy, through low cost and fast to implement solutions.

Pedestrian crossing: best cases and proposal

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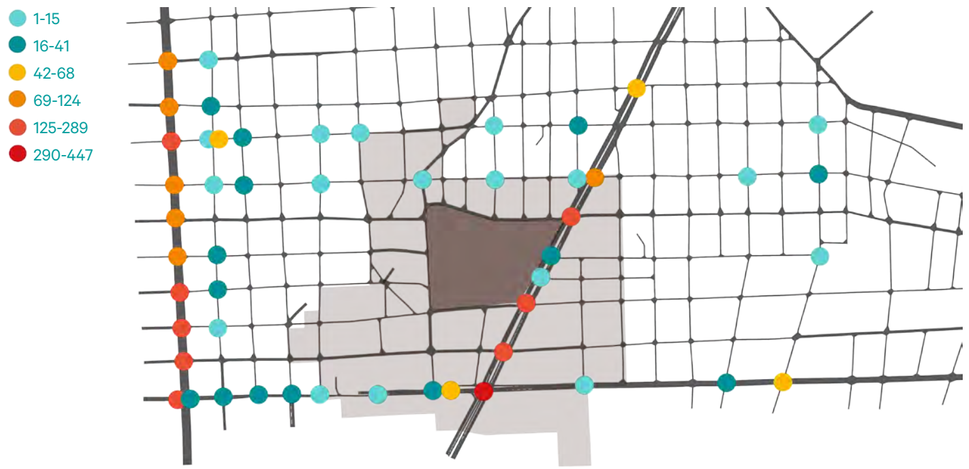
2005-2010 total traffic accidents at junctions
source: “Gestión social para el proyecto de accesibilidad y movilidad preferencial del centro histórico de Guadalajara, 2010”



PARQUE MORELOS AND THE BRT: A BARRIER OR A GETAWAY?

The CCD master plan also includes some proposals for specific and punctual interventions that are part of an holistic approach to pedestrian movements. One of these is the one that involves the Parque Morelos' BRT stop. this location is central to the master plan and constitutes also one of the points with greater potential from an accessibility standpoint, being there the nearest stop of the Macrobus line 1. Considering this, on one side the aim is definitely that of guaranteeing the best accessibility to those travelling by public transport and allowing to create a natural welcoming access to the park. On the other side the BRT station is currently a totally impermeable system, that runs along the whole plot and prevent any permeability except form the two crossing points at San Diego and Juan Manuel. Taking into account the distances and the pedestrian desire lines potentially associated with the renovation of Parque Morelos, it has been considered the possibility of opening a third pedestrian crossing, central with respect to the BRT station. This solution would bring two major advantages. First of all the described increase in pedestrian connectivity, balancing the crossability on the Calzada independencia. Secondly, the possibility of accessing the BRT stop from the centre, increasing the accessibility to and from the public transport system. This configuration will of course require to add two more toll points in order to allow the tickets' control, but, given the technology already available, there are no feasibility problems with respect to this issue.
A first analysis of the advantages ad disadvantages has been carried out, highlighting the issues that would need to be further addressed whit the detailed design of the proposal. Among these:

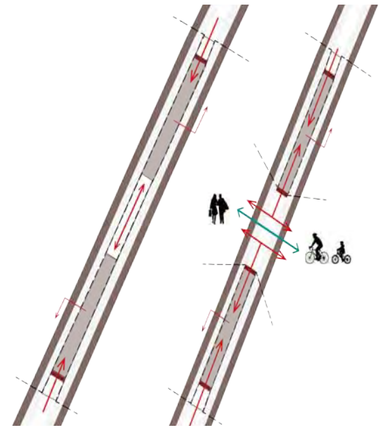
- the preservation of the Macrobus transit corridor, which is both related to the success of the optimization plan for the public transport systems as well as to guaranteeing the safety of pedestrian crossing at the station; this will be solved by installing a pedestrian traffic light coordinated with the rest of the system and to the BRT service
- the presence of a difference in level between the road and the BRT stop will require to consider ramps for disabled people and potentially for bikes; the concept proposals here considered show two possible layouts, that allow to host such ramps. Option 1 requires a lighter intervention on the stop but to the detriment of the pedestrian paths. The only pedestrian flow that would din fact need to cross from one station to the other would be that of people willing to immediately change the direction of travel, which is generally a residual share of movements.
- the evaluation of the actual pedestrian flows related to the boarding and alighting from the BRT as well as to the opening of the pedestrian crossing will have to be part of a quantitative evaluation in order to verify the structure's dimensions

A new pedestrian crossing will increment the connectivity at the BRT station and a careful design of the junctions along the Rambla will guarantee the pedestrian quality of this important connection.

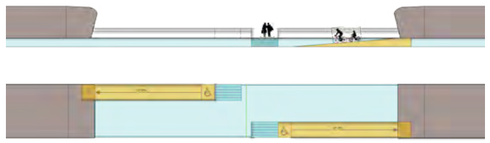
THE RAMBLA AND JUAN MANUEL

Other crucial pedestrian intersections are the ones where the master plan's main pedestrian spine, the Rambla, crosses Juan Manuel and Independencia. Despite the number of vehicles along Juan Manuel street is, for the final phase of the master plan and with the proposed rearrangement of the circulation, in the range of a moderate traffic volume, a particular attention in designing this crossing is required, due to the potentially high pedestrian volumes and to the nature of the Rambla itself. The continuity of the Rambla's paving will be guaranteed and a highly visible road markings will define the crossing area. With regards to the traffic control, the pedestrian zone will be risen with respect to the level of the vehicular road so to enhance the difference between the two environments and to suggest a slowing down of the car flow. Lastly, but fundamental given the flows involved, the introduction of a pedestrian traffic light coordinated with the rest of the signals along Juan Manuel street, that will in any case guarantee a sufficient green cycle for the pedestrian activity to flow smoothly along the Rambla.

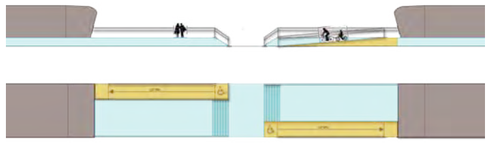
Proposed pedestrian crossing at BRT stop



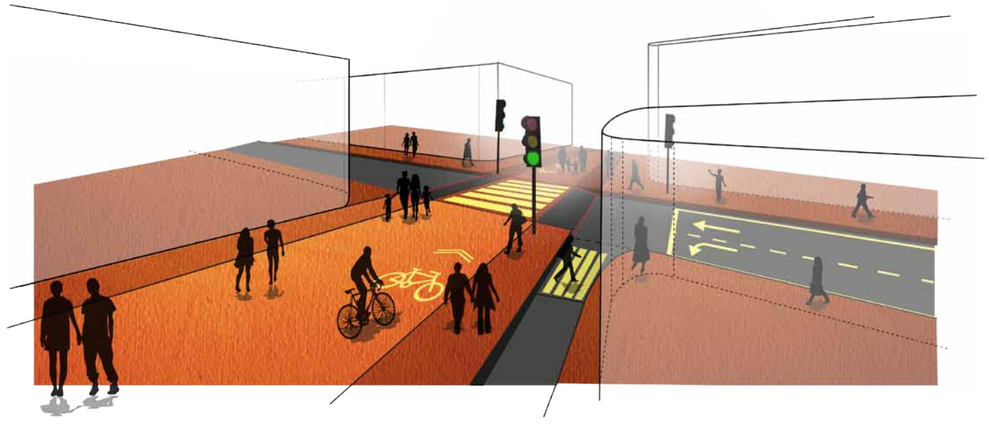
Proposed pedestrian crossing at BRT stop | option 1



Proposed pedestrian crossing at BRT stop | option 2



The Rambla at Juan Manuel: proposed pedestrian crossing configuration



17.3.4.
A road network for all

The maps in these pages show the target proposed in relation to the pedestrian and slow mobility vocation of the CCD road network. To summarize the interventions proposed, a general revision of the overall pedestrian spaces, pavements, curbs, crossings is planned as a first step in order to guarantee a generalized enhancement of the pedestrian quality of the network. As will be shown in detail in the next paragraph, a revision of the road sections in order to keep the functionality while improving the exploitation of the available ROW is at the base of this geometry modifications. Along with this layer, common to all of the master plan area, some specific axes will be enhanced as particularly central fro the pedestrian frame of the project. The main junctions that are to be improved are also highlighted. The master plan pedestrian network have its focus in the north-south Rambla axis, that links in first place all the main public or social spaces of the master plan: the Ingenium Campus, the park and its pavilion, the M4 museum and the Accelerator. This connector is also the element that phisically links the CCD to the city centre pedestrian heart: the Paseo Degollado and Plaza Tapatía. What now is a small and low quality pedestrian bridge across the Hidalgo road, will become the gateway to the digital hub from the Guadalajara historic centre. Dually, the now narrow and little visible cut through the buildings will turn into an integrated pedestrian passage that becomes part of the buildings defining its own space and importance. The third and fundamental role that the Rambla will play is to catalyse the pedestrian potential of the site, and lead it to meet the retail corridor at the junction with Juan Manuel street. The natural expansion of the master plan in phase 2 will start from this point and percolate along the new east - west line. Another crucial point of the CCD's pedestrian plan is the connection between Plaza Tapatía and the street level along the Calzada Independencia. Enhancing this vertical link that today is not only very poor from and architectural and urban quality perspective, but also very little visible from the Plaza, completes the frame of the pedestrian accessibility to Parque Morelos. In this frame, turning the southern part of Aguafría into a pedestrian street is part of a regeneration of the degraded areas and it also provides a second important preferred pedestrian access to the CCD. It should be in fact considered that the Hidalgo/Calzada Independencia junction not only hosts the pedestrian flows from Plaza Tapatía, but also those from the San Juan de Dios public transport stop. Hence the importance of providing high quality connections along the east side of the master plan. The requalification of the pedestrian crossing along the Calzada Independencia as well as the introduction of a new one at the park's BRT stop are aligned with this planning approach. The cycling culture is already deep-rooted in Guadalajara's population and the CCD program for the introduction of a dedicated mobility on demand system perfectly entangles with this context. Considering therefor the vision of a diffuse usage of non motorized modes of transport across the CCD master plan, the need for a comfortable and safe infrastructure is of major importance. The priority given to the pedestrian movement and the corresponding characteristics of the proposed road network are consistent with the needs of the non motorized mobility. The master plan's pedestrian areas will be open to bikes and alternative slow modes of transport, creating a shared non motorized environment where the two flows can coexist. Thanks to the revision of the road sections across the site, dedicated bike lanes are introduced along the Parque Morelos' perimeter, Garibaldi, Juan Manuel and Cabañas. These will sum up to the bike lanes already planned by the Plan maestro de Movilidad Urbana No Motorizada del Área Metropolitana de Guadalajara. Moreover, given the moderate traffic volumes along the master plan's remaining streets and the contained vehicular speed conditions, the rest of the CCD road network will host both bikes and cars on the same network, on promiscuous regimen.

The CCD pedestrian and slow mobility network proposes a general improvement of the pavements and curb conditions, as well as specific interventions focused on crucial axes and junctions.

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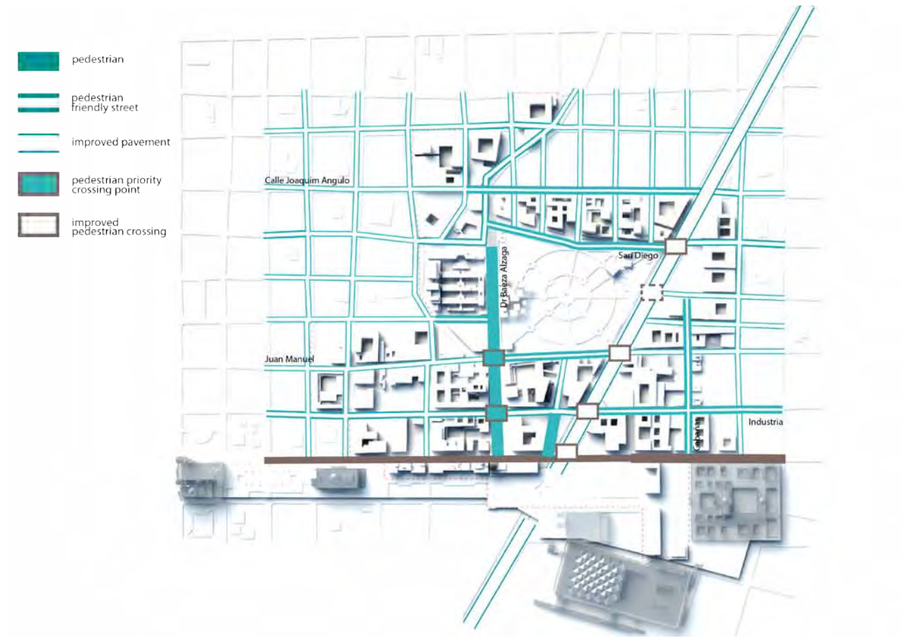
CCD Pedestrian network



CCD Slow mobility network

17.4.

Vehicular accessibility and the road network

17.4.1. Accessibility and circulation

The CCD's master plan vehicular accessibility is greatly influenced by the orthogonal one-way road network system. This configuration channels the traffic along specific axes and, at present and considering the secondary network, the main connectors are Independencia - eastbound - and San Diego/Garibladi - westbound, as per the anticipation of the simulation model here reported. The main flows are of course concentrated along the primary network, and in particular along Hidalgo Ave and Juárez Ave for the east-west connectivity and Calzada Independencia and Alcalde for the north-south connectivity. The separation of the two directions of flow and the prohibition for left turn manoeuvres on both the Calzada Independencia and along the system Hidalgo/Juárez forces traffic onto the secondary network in order to perform all the forbidden movements. The traffic volumes registered and modelled for the year 2012 on the master plan site's roads, that describe the current situation, are generally below the nominal capacity of the considered stretch of road and, in particular to the north of the park as well as along its southern boundary, the flows are within moderate traffic conditions parameters. Nevertheless, the perception of the people walking through the area recalls a highly car oriented environment and this is partially due to the characteristics of the road design, the poor walkways' conditions, the presence of uncontrolled on-street parking and the congestion caused by an inefficient distribution of the bus routes.
Following the forecasted evolution of the vehicular flows at a wider scale, the 2024 scenario, before considering any intervention related to the DUIS area or CCD master plan, doesn't present notable differences from the current situation. This potentially unexpected outcome derives from a balance between the future growth of the city's car fleet and the population reduction of the city centre. Introducing the traffic generated by the DUIS and CCD projects in their final scenario (year 2024), the flows through the CCD rise by a 71% during the morning PH. The two axes that are primarily interested by this increment are San Diego and Juan Manuel that, despite the growth factor being lower than that of other roads, reach the highest car volumes in the Parque Morelos' surroundings. Considering the master plan objective of providing a lively but pedestrian oriented environment in particular in the park's proximity, as well as the presence of the pedestrian Rambla, the site circulation, roaad characteristics and car park access system has been tuned in order to shift a share of the new traffic from those two axes to other parallel roads (in particular to Calle Joaquin Angulo, Herrera y Cairo and Industria), which traffic level will remain within highly acceptable values but will still allow to relieve the centre of the master plan. Moreover, the vehicular circulation layout, while maintaining most of the directions of flow unchanged, reduces to the minimum the necessity of driving though the site, confining the access paths to the site border and encouraging the access to a specific master plan area depending on the place of origin. In order to obtain this goal, as will be shown in detail in the next paragraph, the location of the car parks, their access points and the introduction of a traffic limited zone on San Diego have been used as primary planning elements.

The vehicular circulation layout reduces to the minimum the necessity of driving though the site, confining the access paths to the site border and encouraging the access to a specific master plan area depending on the place of origin.

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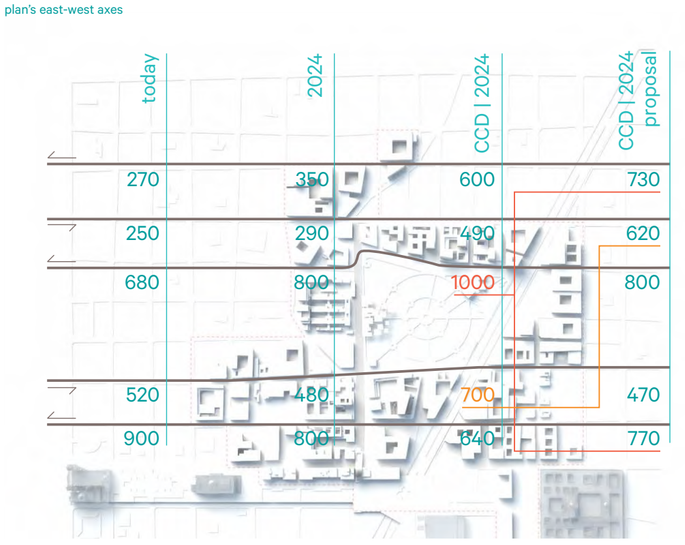
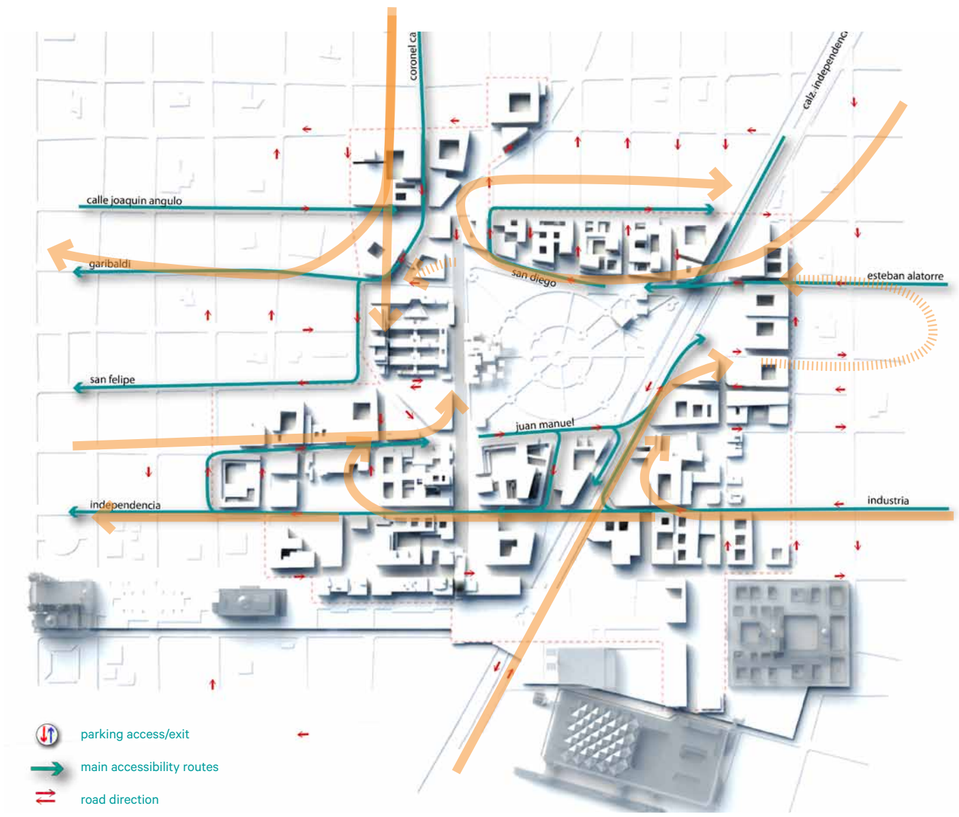
veh/hour in the morning PH for four different scenarios along the master plan's east-west axes



master plan's main access paths



17.4.2. Drop-off and parking access

The envisaged circulation solution takes into account also the access to the different buildings, as well as to the parking facilities. The proposed drop-off layout is focused on combining a functional solution with a strong sense of arrival for the site's users. The north office plot's main drop-off area is located along San Diego, looking on the park and directly accessible from the Calzada Independencia. Dually, the M4 and retail strip's drop-off is facing the other side of Parque Morelos, immediately accessible to all flows coming from the west. Considering the commercial and public functions installed, the necessity of providing ad efficient relation between the external road network and the parking accesses, as well as between these ones and the drop-off areas is of paramount importance in order to guarantee a smooth circulation within the site. Therefore each building's drop-off should have a direct relationship with both the external road network and the relevant parking facilities. It should consequently be possible to enter the car park after drop-off, and to return to the pick-up after exiting the car park. Moreover, both drop-off and car park should have access to and from the street. The map highlights some of the master plan's drop-off areas, along with the public parking access points. These are generally located on the secondary or local roads, in order to avoid producing excessive friction on the main traffic corridors. Parking ramps, whenever possible, have been located externally with regards to the site, in order to reduce the vehicular penetration. Of particular interest are the accesses of the main master plan's underground public parking under the Rambla. This structure tends to be the most exploited, even if the digital and way finding management system will help redirecting the users to the most suitable facility. This considered, a set of scattered ramps helps distribution the car flows on the road network, diversifying the routing options. Focusing on two of the main forecasted vehicular access directions, the considered central car park presents a southern access ramp on Juan Manuel street which will take away from the road network the inbound traffic arriving from the west side. This ramp, along with the exit one located on San Felipe street, is related as required with both the M4 and Accelerator's drop-off by a path looping on Independencia. To the north of Parque Morelos, the traffic related tot he office towers can comfortably drop-off on San Diego street before accessing the underground parking below the office plots. In case the destination car park is the one below the Rambla or even the one west of the Ingenius Campus, the vehicles can drive towards Garibaldi road to access. This configuration, where San Diego is dedicated to the master plan's users, prevents through traffic from passing on the selected link, relieving the volumes along the park.

The envisaged circulation solution takes into account the access to the different buildings, as well as to the parking facilities, considering that each building's drop-off should have a direct relationship with both the external road network and the relevant parking structures.

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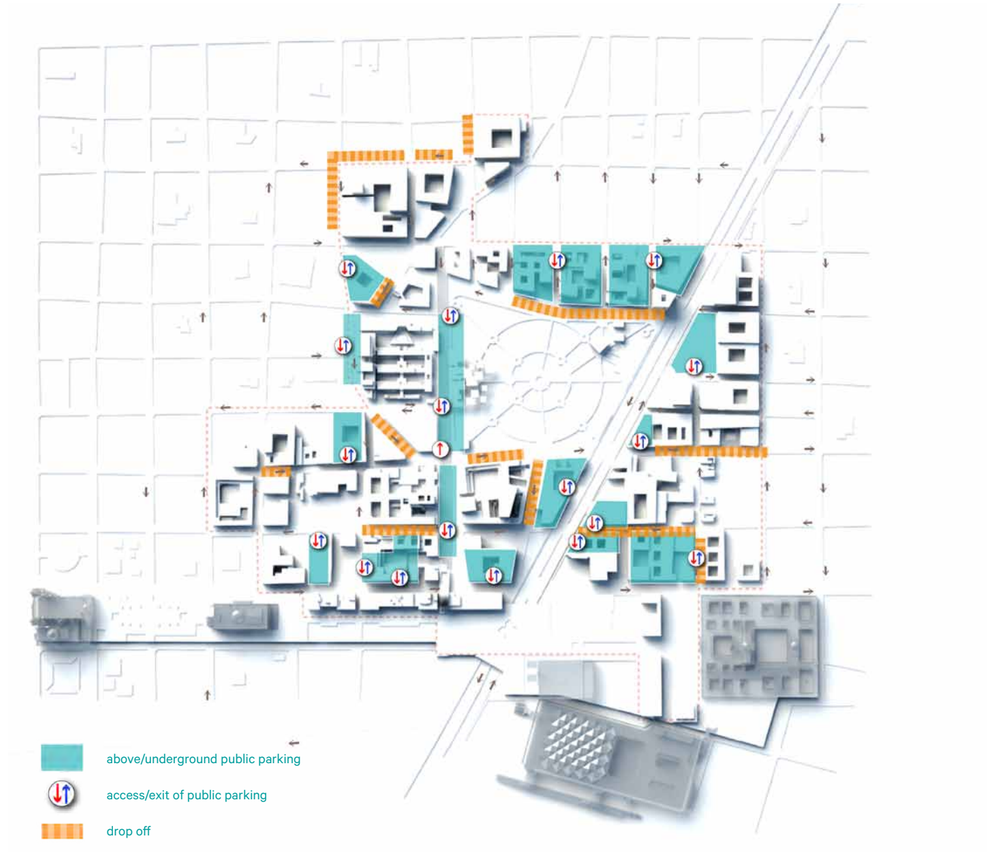
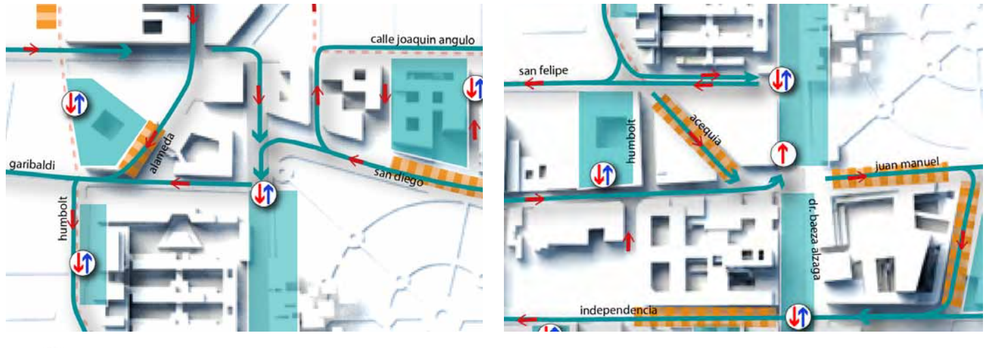
master plan's car park accesses and drop-off areas



North and south side of the Rambla car park: relation between access ramps and drop-off areas



17.4.3. Typological road sections

In order to achieve the targets set for the internal master plan's vehicular circulation, a series of modifications to the road sections have been introduced. These variations to the roads' geometry have been tested with the implemented micro-simulation model, that will be described in greater detail in the next paragraph. The set of solutions here presented is the final outcome of the modelling activity, aiming at providing the optimized configuration in terms of vehicular circulation, as well as of pedestrian and non motorized circulation. The quantitative guidelines have then been applied so to also improve the overall quality of the road space, including the on-street parking distribution which will be further described in paragraph 16.6. The main modifications introduced are aiming on one side at allowing the previously described offsetting of the main traffic flows away from the immediate proximity of the park, and on the other side at guaranteeing a general continuity in the east-west connectors road section, so to avoid any potential bottle neck effect. The road network has been therefore modified as follows:

- in the frame of reducing the flows through implementing a traffic calming approach, Juan Manuel and San Diego streets become one lane. On-street parking and pavements are re-arranged accordingly
- in order to guarantee continuity to the axis and to allow a higher capacity, the stretch of Industria east of the Calzada Independencia becomes a two lanes road
- Calle Joaquín Angulo, in correspondence of Parque Morelos, becomes a two lanes road. This in order to reduce the impact of several elements of friction that are concentrated in that area, such as the parking accesses and the bus stops, by providing a dedicated bus lane
- road junctions on the Calzada Independencia are characterized by the presence of dedicated turning lanes in order to increase the nodes' capacity

The modifications proposed to the road sections aim at optimizing the vehicular as well as the pedestrian and non motorized circulation, offsetting the main traffic flows away from the immediate proximity of the park and improving the pedestrian environment.

Wherever possible, the pavements have been widened as a consequence of the traffic lane width revision or of the removal of unnecessary on-street parking. The road sections proposed for bordering Parque Morelos are intended as strongly pedestrian oriented, with dedicated MoD lanes and wide pavements for outdoor activities, as well as for allowing the drop-off to the buildings. Other specific and punctual road stretch are indicated as two lanes due to the presence of two-way car park access. In the next pages some examples of typical road sections referred in particular to the parts that have been modified with the present proposal.

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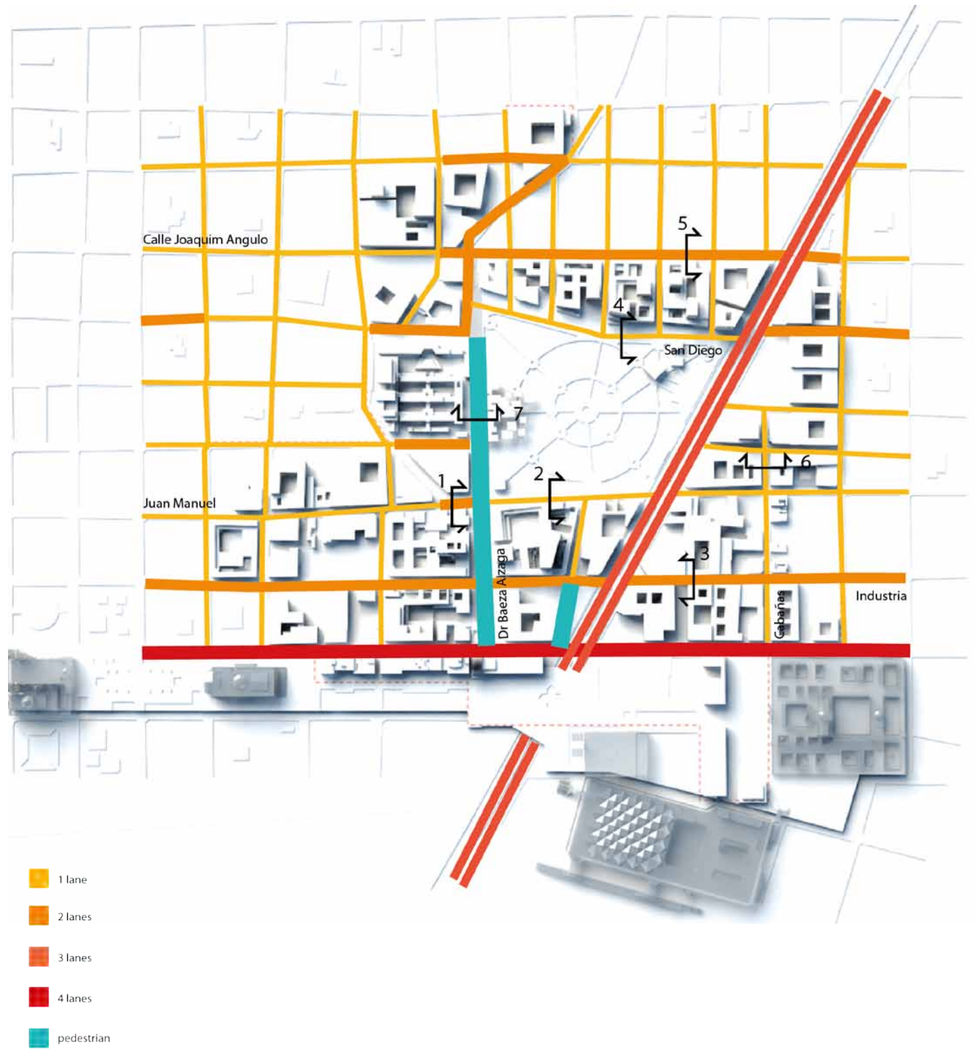
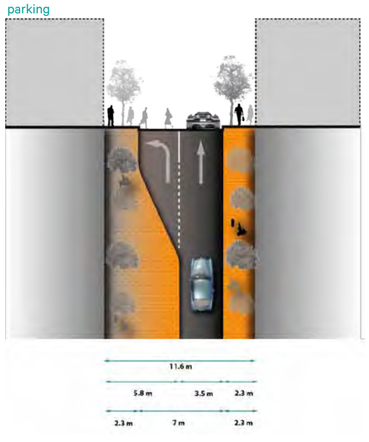
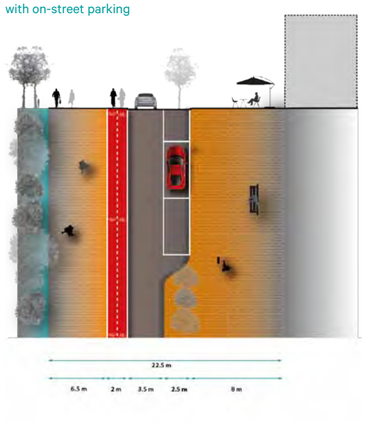
master plan's geometrical road hierarchy.
The lanes' number considers both vehicular and transit only lanes.



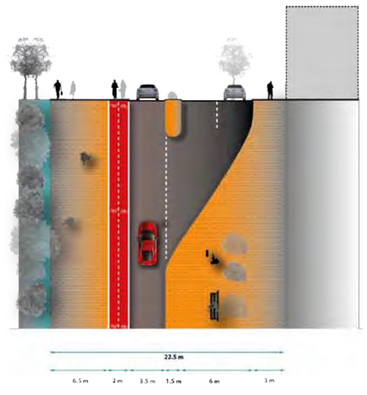
section 1. Juan Manuel at the Rambla with dedicated lane for left turn into underground parking



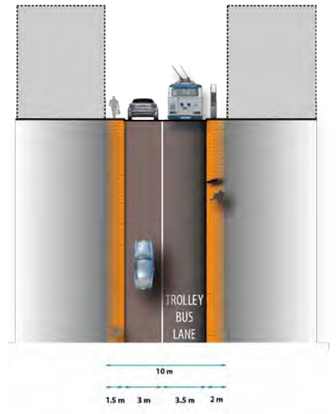
section 2. Juan Manuel at Parque Morelos with on-street parking



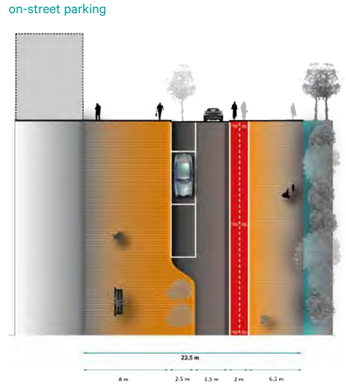
section 2. Juan Manuel at M4 building's drop-off



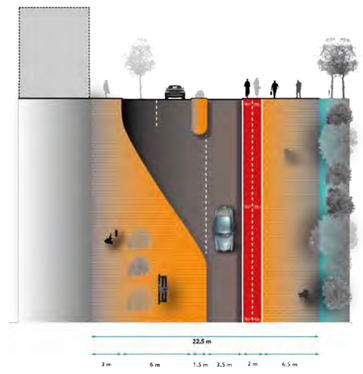
section 3. Industria



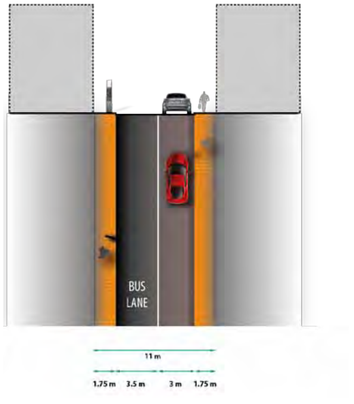
section 4. San Diego at Parque Morelos with on-street parking



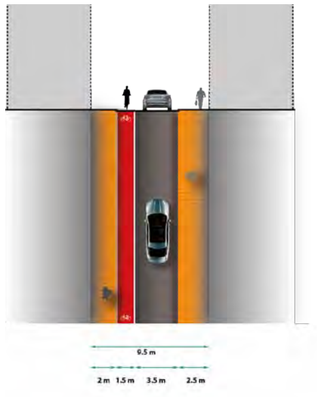
section 4. San Diego at office building's drop-off



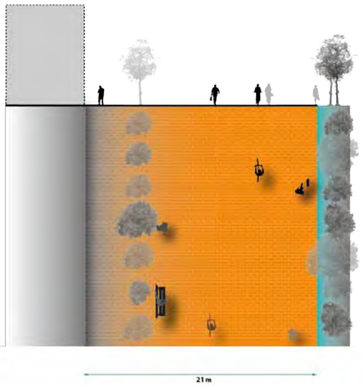
section 5. Joaquin Angulo



section 6. Cabañas



section 7. the Rambla



17.5.

Quantitative analysis and model simulation for the CCD

17.5.1 Analysis of Existing Conditions

GENERAL APPROACH TO TRAFFIC ASSESSMENT

In order to generate a quantitative assessment of traffic conditions in the study area, a trip and parking generation exercise was carried out to address the traffic produced by the new development quantities. At the same time, an analysis of existing conditions was carried out through data in literature and available field study information such as the "Estudio de movilidad y accesibilidad urbana para el polígono de Desarrollo Urbano Integral Sustentable" by EPS which will be referred to as [1] in the rest of this chapter.

Methodology-wise, it was necessary, given the scale of development, to build a traffic micro-simulation model to simulate traffic conditions in some detail. The modelling, as well the quantitative analysis in general, focus on the current condition (e.i. year 2012) and the forecast year at completion of Phase 3 of the master plan (e.i. target year 2024).

The software modelling suite used for this detailed simulation exercise was PARAMICS by Quadstone - the capabilities of the software are described later on in this chapter.

METHODOLOGY STATEMENT

According to standard Traffic Impact Study Methodology the goal is to produce a Baseline scenario and one (or many) Project scenarios proposed for the DUIS development area, for year 2024 in order to appreciate the effectiveness of proposed strategies and mitigations.

Prior to running the future traffic scenarios it is necessary to prepare the existing condition model basing on the knowledge of the context derived from observed data. Once the existing condition model (2021) is built, calibrated and able to replicate the surveyed conditions, then one can move on to creating future scenarios either by revising the road network or the trip matrices to reflect the "target year" future conditions (e.i. 2024). Initially, the future year is modelled with only the planned projects and traffic demand which is not related to the proposed project (in this case the CCD). This is generally called Target Year Baseline or Reference.

Then, the assumed trip matrices for the target year 2024 situation are then fed into the traffic model to account for the traffic produced and attracted by the CCD. This is called the Project Scenario.

Project-specific circumstances may add to this very basic workflow scheme additional scenarios useful to determine intermediate steps between the existing conditions and the final stage, or to address specific elements of either the demand and the network.

In the case of CCD, an intermediate scenario was set up to establish road network conditions within the Poligono DUIS in 2024 with the expected development in sub-areas 1 and 2 prior to implementing the CCD.

In addition, multiple network configurations and sensitivity tests were carried out to motivate the chosen/proposed mobility strategies.

STUDY AREA

The study area chosen for the micro-simulation modelling exercise covers the extent of the Poligono DUIS as highlighted in [1]. Provided that significant information was already available at the scale of the DUIS, given that the proposed strategies required an area much grater than the master plan to be correctly tested with a traffic model, and deeming that results could be more comparable if carved out of models with the same study area extent, it was decided to adopt the same study area as in [1].

Thanks to [1] it was possible to take advantage of the following information useful to correctly build the model of the existing condition:

- recently observed traffic counts at intersections adjacent to Parque Morelos (March 2012),
- the Origin-Destination Matrix (e.i. the traffic demanding to travel across the study area of the entire Poligono DUIS);
- traffic signal plans for 97 intersections across the study area
- the trip generation for the sub-poligono 1 and sub-poligono 2 as part of the redevelopment of the DUIS, but not yet within the perimeter of the CCD
- socio-demographic information for the Poligono DUIS which informed the trip generation process of the CCD described later in this chapter.

TRAFFIC SURVEY

Traffic survey were carried out at locations highlighted in the map here on the left whereas the study area extent is represented by the red dotted line.
It is clear that the information concentrates on traffic volumes and their distribution on the network only in the surroundings of Parque Morelos. Despite this is not and ideal arrangement, this is considered acceptable because the master plan, object of our evaluations, focuses on the blocks along the perimeter of the park and, overall, there is a "study area-wide" Origin-Destination Matrix already structured which represents a valid starting point.

Key data regarding traffic counts are:

- 20 manual counts positions where observations took place during the AM peak from 7.00 until 9.00 o'clock.
- a vehicular classification in three classes - cars, buses and heavy vehicles.

To be underlined is the dominant position of private transportation vehicles, however the share presented below are representative exclusively of the traffic flows investigated in the survey; therefore it only applies to local traffic condition around the DUISS polygon.

The data observed demonstrate that the peak traffic in the morning is between 8:00 and 9:00 thus electing this interval as the one for the modelling activity.

traffic model study area and traffic counts locations

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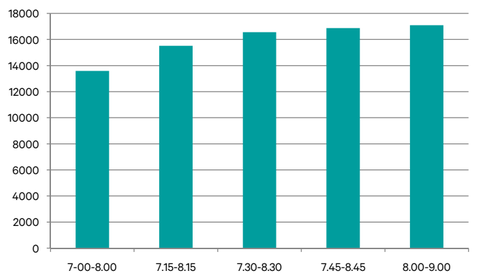
According to standard Traffic Impact Study Methodology the goal is to produce a Baseline scenario and one (or many) Project scenarios proposed for the DUIS development area, for year 2024 in order to appreciate the effectiveness of proposed strategies and mitigations, along with the implementation of the CCD master plan.

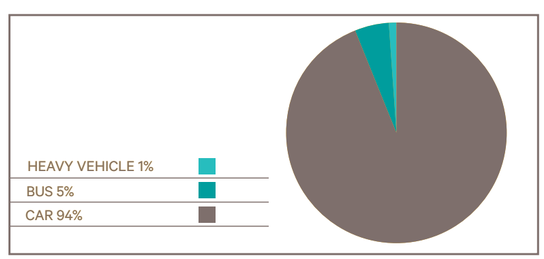
EPs traffic suveys' summary | traffic counts' overall figures

15 minutes interval	Car	Bus	Heavy Vehicle	TOT
7.00-7.15	2366	142	33	2541
7.15-7.30	3046	153	57	3256
7.30-7.45	3462	183	43	3688
7.45-8.00	3889	156	60	4105
8.00-8.15	4204	211	53	4468
8.15-8.30	4015	205	77	4297
8.30-8.45	3767	180	58	4005
8.45-9.00	4044	205	72	4321
TOT	28793	1435	453	30681
%	94%	5%	1%	100%

EPs traffic suveys' summary | hourly traffic data for PH estimation



EPs traffic suveys' summary | modal share as per traffic surveys



17.5.2 Existing Conditions Model

NETWORK MODELLING

The Q-PARAMICS model dynamically simulates traffic phenomena and simulates real time vehicle behavior. It offers area wide vehicle routing with dynamic feedback to accommodate traffic flow modeling for situations where signals are likely to be operation. The model depicts the movements of individual vehicles and follows them from the time they enter the study area network to the time they exit the network.

The first step of the modeling process therefore involved the construction of the current traffic network to be simulated. For this, the actual physical road system was converted into a computerized format composed of links, nodes and zones. The road network was designed also starting from the information included in [1]. This includes:

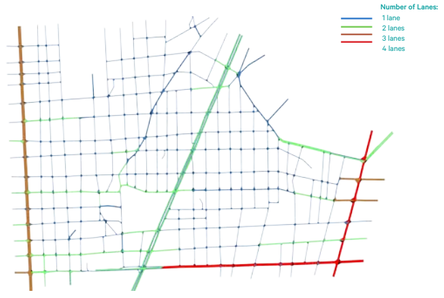
- road configuration (number of lanes, speed limit; etc...)
- signal system and intersection priority management;
- public transport system (official and unofficial stops, PT road map)

Diagrams and plans in these pages show the comparison between the model set up by EPS for the Poligono DUIS and the model layout set up by MIC for the CCD.

The first step of the modeling process therefore involved the construction of the current traffic network to be simulated. The images highlight the good alignment of the EPS and the MIC models, through a comparison of the network characteristics.

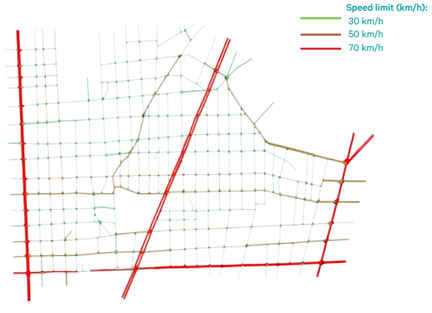
traffic model characteristics - number of lanes by EPS

traffic model characteristics - number of lanes by MIC



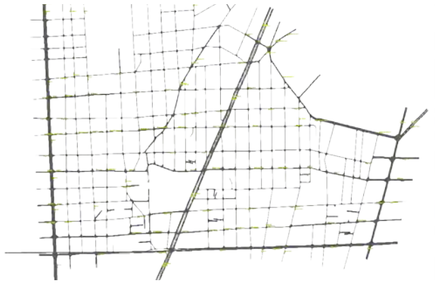
traffic model characteristics - target speed by EPS

traffic model characteristics - target speed by MIC



traffic model characteristics - bus stops by EPS

traffic model characteristics - bus stops by MIC



DEMAND STRUCTURE AND TRAFFIC ASSIGNMENT

In the "existing condition scenario" (e.i. year 2012), the total number of vehicles assigned to the modelled road network is summed up in the table on the right.
A set of 58 zones, identifying alternatively the "Origin zone" or the "Destination zone", has been established addressing points on entry and exit from the network.
The zones' scheme is displayed in the map below;

Zone number 58 has been placed to model the presence of area with particular vehicles generation/attraction attitude. In this particular condition it represents a proxy for its attracted and generated traffic. The road network system has been designed in the traffic simulation software with great accuracy exactly as it is in the reality.

For modelling purposes, two different O-D matrices, one for cars and the other for the heavy vehicles, for the peak hour 8.00 -9.00 AM as established by the surveys.
For improving the realism of the simulation, it's standard practice that a preloading value of 10% of the peak hour traffic is assigned to the road network in the quarter of an hour 7.45 - 8.00 - these are generally known as shoulder peaks.

The model uses a dynamic assignment approach in which vehicles travel from origin to destination zone using the least costly routes.
The assignment technique is achieved by applying a generalized cost function which takes into consideration the time it takes to complete the journey between origin and destination.

The costs are specified for each link and take the form of the following:

Cost: avT + b * D + C * P

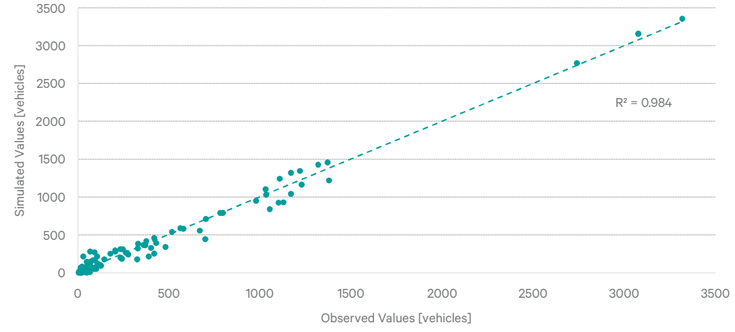
Where :
a: time coefficient in minutes, in this case equal to 1.
b: distance coefficient in minutes per km, in this case equal to 0.34
c: toll coefficient in minutes per monetary cost, equal to 0.

The validated (or balanced) traffic counts derived from the surveys described in the previous section were then utilized to not only set the trip ends of the matrices, but also to set the tuning and link screen counts at given locations. The matrices were built starting from the matrices used for the previous EPS's study [1].

The traffic matrices are then assigned onto the modeled network and comparisons between modelled and observed (real) flows at specific locations carried out. This process is known as Model Calibration.

The model uses a dynamic assignment approach in which vehicles travel from origin to destination zone using the least costly routes.
The assignment technique is achieved by applying a generalized cost function which takes into consideration the time it takes to complete the journey between origin and destination.

model calibration curve



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17.5.3
Model Calibration

The output of the micro-simulation process will only achieve proper validation if the road network and traffic demand have been properly specified.

For this study the calibration process involved choosing suitable model parameters such as vehicle characteristics, driver aggressiveness, driver awareness, target headway and reaction times to provide realistic results.

Usually, most of these were chosen based on previous experience in using the model in similar conditions elsewhere, but as described in the previous paragraphs, in this case they were adapted to the locally observed conditions.
Flow comparisons were conducted at about 40 screen locations, including turning movements comparisons at junctions.

To understand how close the model's traffic output reflects the current conditions observed on the network in the traffic surveys the R-squared coefficient was adopted.

The R-squared coefficient, a statistical technique whereby a straight line is fitted to a set of data points to measure the effect of a single independent variable.

Modelled and observed values displayed in the chart and table on the right are referred to the morning peak hour 08:00-09:00.

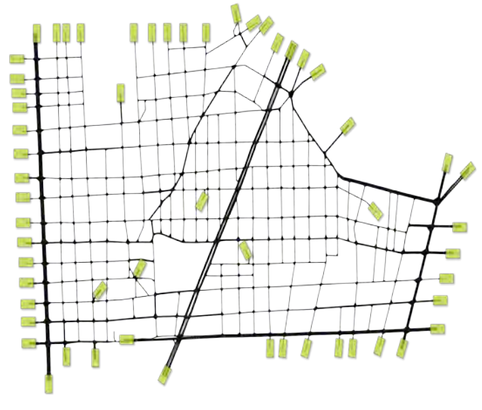
The slope of the line is the measured impact of that variable. Comparisons of traffic volumes and turning movements at junctions fulfilled an R2 value of 0.99 for the AM and PM peaks, for both the Friday and Saturday simulations, as indicated in figures on the right. For the modeling exercise values of R2 higher than 0.95 were considered acceptable.

O/D matrix summary

ZONE	AM	OUT
1	2215	2195
2	163	0
3	0	434
4	428	0
5	0	170
6	156	0
7	0	94
8	128	0
9	0	140
10	0	176
11	259	0
12	0	129
13	197	0
14	0	546
15	479	0
16	0	170
17	527	0
18	0	139
19	389	0
20	0	181
21	411	0
22	0	135
23	485	0
24	0	330
25	2464	1944
26	1517	978
27	0	189
28	98	0
29	0	335

ZONE	AM	OUT
30	0	218
31	71	0
32	0	366
33	4100	0
34	0	535
35	955	0
36	0	760
37	414	0
38	114	1105
39	85	93
40	563	316
41	0	52
42	1315	1254
43	36	0
44	0	157
45	303	42
46	316	0
47	0	3418
48	0	1880
49	1355	0
50	112	215
51	799	437
52	162	736
53	345	356
54	0	320
55	228	0
56	0	150
57	0	394
58	100	200

micro-simulation model's zoning



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17. 5. 4
Existing Condition Model: Network Performance

To evaluate the level of performance of the modelled network a set of parameters has been selected.

- Total Vehicle distance, expressed in kilometers, representing the sum of the total distance covered by each single vehicle on the modelled network, during the two hour model simulation.
- Average speed, expressed in kilometers per hour, calculated as the total time spent by all vehicles on the modelled network, divided by the total vehicle distance covered during the two hour simulation.
- Total Vehicle count is the cumulative number of vehicles assigned to the modelled network during the two hour simulation;
- Total Demand is the theoretical number of vehicles to be assigned to the network, defined in the model design stage prior the running of the simulation. In this particular case the Total Demand corresponds to the total number of vehicles observed on the road system during the survey.
- If the model works properly the Total Vehicles count parameter should be very close, in numbers, to the Total Demand parameter, meaning that the designed vehicles quantities are completely assigned to the modelled network.
- Therefore the Assigned Demand (%) expresses the percentage of the Total
- Demand successfully assigned to the network.

These parameters are fully representative of the modelled network conditions.

After several simulations for the 2012 Current Condition Scenario, the model was calibrated and a good match between the Total Vehicle Count and the designed quantities (Total Demand) was obtained. See table below.

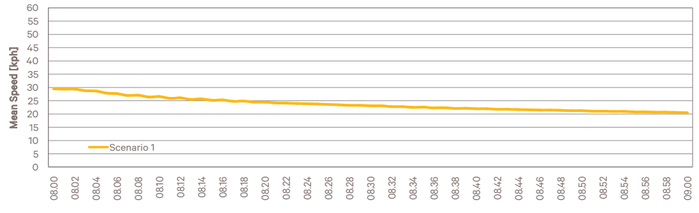
The chart below presents the trends of the Average speed parameter during the Peak Hour simulation; for the simulation the model runs have been carried out.

Mean speed trends fall inside an interval ranging from about 30 kph to 20 kph.

The cumulative average speed at the end of simulation time is quite similar to the value produced by the model of EPS (20.5 vs 19. 4 km/h). This testifies the reliability of the model.

The table below presents the traffic values for the roads that most affecting the CCD area.

The cumulative average speed at the end of simulation time is very close to the value produced by the model of EPS (20.5 vs 19. 4 km/h), thus testifying the reliability of the model.



Scenario	Performance								
	avg. travel time [sec]	tot travel time (s)	tot veh distance (m)	vehicles assigned	mean veh speed [kph]	tot. vehicle travelled distance	tot. travelled time [h]	matrix dimension	assigned vehicle vs n° of veh. in matrix
Scenario 1	228	5067983	28219029	21362	20.5	28219	1408	21372	100%

Scenario	Traffic (veh/h)				
	Herrera y Cairo	Joaquin Angulo	San Diego	Juan Manuel	Av. Independencia
Scenario 1	269	249	684	525	917

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17. 5. 5
Future Scenarios

BACKGROUND TRAFFIC GROWTH

The assessment of the future traffic conditions is quite onerous over the medium-long term and it is usually derived from regional master planning documents setting the trends for the future.
In the absence of such framework a thorough approach was used: starting from data derived from [1] by EPS, and presented in the table below.

Population	2010	31825 inhab
Pop. Growth Rate	2000-10	-1.70%
Vehicles	2010	3132 veh
Vehicles Growth Rate	2010-15	2.83%
	2015-20	1.04%
	2020-25	0.65%

The first step was distinguish the traffic that composes the Current Condition Matrix (Scenario 1) in crossing and internal traffic always referring to the DUIS area. In this way two different matrices were generated:

- Crossing Traffic Matrix = 17977 veh
- Internal Traffic Matrix = 3312 veh

The procedure for calculating the background traffic of 2024 was different for the two matrices. It is presented below

Crossing Traffic Matrix

$C\_Matrix_{VEH\ 2024} = C\_Matrix_{VEH2012} \cdot (1+ i_{10-15})^{n1} \cdot (1+i_{15-20})^{n2} \cdot (1+i_{20-25})^{n3} = 21125$ veh

where:
i_{10-15}=Vehicles Growth Rate for 2010-2015 =2.83%
i_{15-20}=Vehicles Growth Rate for 2015-2020 =1.04%
i_{15-20}=Vehicles Growth Rate for 2020-2025 =0.65%
n1 = 3 years
n2= 5 years
n3 = 4 years

INTERNAL TRAFFIC MATRIX

In this case the process can be more accurate thanks to the available data of DUIS area, considering also the trend of population. The first step was calculate vehicular rate for the 2024 with the formulas below.

$\%_{VEH\ 2010} = Vehicles_{2010} / Population_{2010}$

$\%_{veh\ 2024} = \%_{VEH\ 2010} \cdot (1+ i_{10-15})^{n1} \cdot (1+i_{15-20})^{n2} \cdot (1+i_{20-25})^{n3}$

where:
n1= n2 =5 years; n3= 4 years

In the second an O-D Matrix expressed in terms of Population has been built using the following correlations.

$I\_Matrix_{VEH\ 2010} = I\_Matrix_{VEH\ 2012} / (1+i_{10-15})^{n1}$

where:
n1 =2 years

$I\_Matrix_{POP\ 2010} = I\_Matrix_{VEH\ 2010} / \%_{VEH\ 2010}$

$I\_Matrix_{POP\ 2024} = I\_Matrix_{POP\ 2010} \cdot (1+ I_{00-10})^{n}$

where:
n=14 years
In the end, the matrix of vehicles is calculated.

$I\_Matrix_{VEH\ 2024} = I\_Matrix_{POP\ 2024} \cdot \%_{VEH\ 2024} = 3172$ veh

In addition, another matrix has to be evaluated, the Induced Traffic Matrix that represent the security coefficient of the process and it is equal to the 5% of the Crossing Traffic Matrix fro 2024:

In_Matrix = C_Matrix . 5% = 1056 veh

EXISTING CONDITION
- **Scenario 1** – 2012 condition ⟶ **21372 veh/h**

REFERENCE 2024
- **Scenario 2** - 2024 reference Scenario ⟶ **25147 veh/h**

DUIS 2024
- **Scenario 3** - Scenario 2 plus the traffic generated by Poligono 1 and 2 ⟶ **25451 veh/h**

CCD 2024
- **Scenario 4A** - Scenario 2 plus the traffic generated by Poligono 1,2 and 3 (CCD) ⟶ **30429 veh/h**
- **Scenario 4B** – -15% of traffic with respect to SC 3 to account for policies to reduce traffic in the city center (Road Pricing, Park Pricing, Ring Road etc... ⟶ **25865 veh/h**

CCD 2024
- **Scenario 5A** - Traffic of Scenario 4° (**30429 veh/h**) with road network changes proposed by MIC
- **Scenario 5B** – Traffic of Scenario 4B (**25865 veh/h**) with road network changes proposed by MIC

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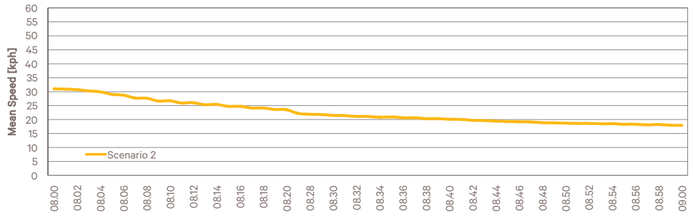
17. 5. 6
Scenario 2

As anticipated at the beginning of the chapter, this is the so-called "Reference" scenario (e.i. conditions projected at year 2024 including only current trends and already established policies).

- The O-D Matrix only contains the background traffic calculated as explained in the previous paragraph with a total traffic equal to 25147 veh/h.
- The road network keeps the same configuration as the baseline scenario (Scenario 1).
- In this scenario the growth of traffic produces the decrease of road performance both in terms of Mean Speed and percentage of assigned vehicles.
- In this case the correlation between traffic growth (+18%) and mean speed (-13%) is less than linear, this fact testifies that the network is not yet in congestion and offers opportunity to allocate traffic demand.
- The increase in the number of unreleased vehicles (3%) witnesses congestion localised at selected locations along the perimeter of the network.



Scenario 2 represents the conditions projected at year 2024 including only current trends and the effect of already established policies.

Scenario	Performance								
	avg. travel time [sec]	tot travel time (s)	tot veh distance (m)	vehicles assigned	mean veh speed [kph]	tot. vehicle travelled distance	tot. travelled time [h]	matrix dimension	assigned vehicle vs n° of veh. in matrix
Scenario 2	284.9	7294322	34954042	24293	17.9	34954	2026	25147	97%

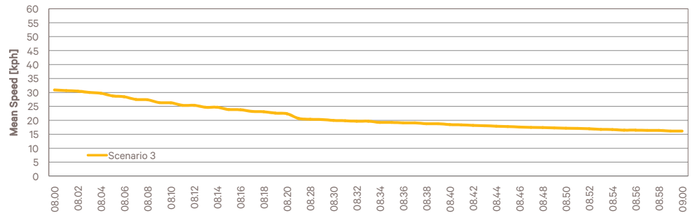
Scenario	Traffic (veh/h)				
	Herrera y Cairo	Joaquin Angulo	San Diego	Juan Manuel	Av. Independencia
Scenario 2	351	288	826	483	817

17. 5. 7
Scenario 3

This scenario includes the Reference Scenario for the year 2024 plus the traffic generated by Polygon 1 and 2 for a total value of 25451 veh.

The road network keeps the same configuration as Scenario 1 and 2.

In this case the low increase in traffic does not produce significant changes in network performance.



Scenario 3 represents the same conditions as per scenario 2, plus development in polygons 1 and 2 of DUIS.

Scenario	Performance								
	avg. travel time [sec]	tot travel time (s)	tot veh distance (m)	vehicles assigned	mean veh speed [kph]	tot. vehicle travelled distance	tot. travelled time [h]	matrix dimension	assigned vehicle vs n° of veh. in matrix
Scenario 3	309.9	8097382	34849527	24680	16.2	34850	2249	25451	97%

Scenario	Traffic (veh/h)				
	Herrera y Cairo	Joaquin Angulo	San Diego	Juan Manuel	Av. Independencia
Scenario 3	278	289	725	502	830

17. 5. 8
Trip Generation

The trip generation is the first step in the conventional transportation forecasting process, widely used to forecast travel demand. It predicts the number of trips originating in or destined to a particular traffic analysis zone.

The trip generation analysis is based on the land use and site-specific inputs useful to build a picture of how a place shall function, by whom and of course how it will be reached by its users.

The starting point are usually the design quantities such as the Gross Floor Area (GFA), the number of dwelling units, the number of hotel rooms, the seating provided at convention facilities etc... The CCD is characterized by the design quantities highlighted in the table that follows and, as far as mobility strategies are concerned, in two main phases: Phase 1 and Phase 3.

The trip generation rates and parameters used in the computation were mainly taken or derived from local sources and international standards (mainly U.S.A. based), adapted to the conditions in Guadalajara. These include:

- "Estudio de movilidad y accesibilidad urbana para el polígono de desarrollo urbano integral sustentable" by EPS.
- Estudio de demanda multimodal de desplazamientos de la Zona Metropolitana de Guadalajara, actualización 2007 - Informe 5.
- ITE Parking Generation Manual - 4th Edition.
- Reglamento de estacionamientos en el Municipio de Guadalajara, and
- other sources about socio-economic data, market analysis, demographic trends in the Poligono DUIS provided as part of the project brief.

The trip generation analysis is based on the land use and site-specific inputs and assumptions aligned with the master plan vocation and project's aims.

The process adopted aimed at estimating the population of users of CCD by working with the seven categories that were elaborated on the basis of the data received.

These are:
- Residents;
- Workers of the Creative Industry sector;
- Customers and workers of the Retail sector assuming a split between F&B and non F&B activities of 60%-40% respectively, and
- Students assumed attending facilities in the Institutional/Education field.

In general terms the "Developed Public Space" was not accounted as a self-standing land use category attracting/generating people as a primary destination. It was treated as a subsidiary of the other adjacent land uses and seen as a complement to the experience of living the CCD for primary purposes different from visiting the park.

The computational process involves in this sequence:

- estimation of population willing to access the CCD, and their daily person trip needs;
- the implementation of a PHF - Peak Hour Factor - addressing the share of daily person trips occurring during the peak hour object of the analysis;
- a directional split;
- a mode share distribution, and
- a vehicular occupancy factor where relevant.

The assumptions for the AM and PM peak hours are summarized in the table aside.

Trip generation assumptions table

	istitutional, educ. STUDENTS	creative industry EMPLOYEES	developed public space VISITORS	General Retail | WORKFORCE EMPLOYEES	General Retail | CUSTOMERS CUSTOMERS	Restaurants + F&B | WORKFORCE EMPLOYEES	Restaurants + F&B | CUSTOMERS CUSTOMERS	New Residential RESIDENTS
Ratio sqm/person	13.00	20.00	1.00	25.00	2.50	25.00	5.00	35.71
unit	sqm/students	sqm/employee	sqm/visitors	sqm/employee	sqm/customers	sqm/employee	sqm/customers	sqm/resident
Daily Person Trip Rate	2.00	3.75	0	2	2	2	2	2.28
Peak Hour Factor - AM	38%	18%	0%	15%	5%	15%	10%	10%
Directional split - AM - % IN	90%	90%	50%	80%	50%	80%	50%	30%
Directional split - AM - % OUT	10%	10%	50%	20%	50%	20%	50%	70%
Mode share								
Caminé exclusivamente	48.7%	19.4%	37.4%	14.2%	37.4%	14.2%	37.4%	37.4%
Transporte colectivo	27.0%	39.9%	28.3%	39.9%	28.3%	39.9%	28.3%	28.3%
Transporte Privado	18.9%	31.1%	27.2%	36.3%	27.2%	36.3%	27.2%	27.2%
Bicicleta	1.2%	3.4%	2.2%	3.4%	2.2%	3.4%	2.2%	2.2%
Transporte de personal	0.0%	3.0%	1.1%	3.0%	1.1%	3.0%	1.1%	1.1%
Taxi	0.3%	0.4%	0.9%	0.4%	0.9%	0.4%	0.9%	0.9%
Transporte escolar	2.6%	0.0%	0.5%	0.0%	0.5%	0.0%	0.5%	0.5%
Motocicleta	0.2%	1.0%	0.5%	1.0%	0.5%	1.0%	0.5%	0.5%
No especificado	1.1%	1.8%	1.7%	1.8%	1.7%	1.8%	1.7%	1.7%
Vehicular occupancy								
Caminé exclusivamente	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Transporte colectivo	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Transporte Privado	1.20	1.20	1.20	1.20	1.75	1.20	1.75	1.20
Bicicleta	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Transporte de personal	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Taxi	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Transporte escolar	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Motocicleta	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
No especificado	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Peak Hour Factor - PM	3%	18%	0%	15%	25%	5%	25%	12%
Directional split - PM - % IN	10%	10%	50%	30%	50%	40%	60%	60%
Directional split - PM - % OUT	90%	90%	50%	70%	50%	60%	40%	40%
Mode share								
Caminé exclusivamente	48.7%	19.4%	37.4%	14.2%	37.4%	14.2%	37.4%	37.4%
Transporte colectivo	27.0%	39.9%	28.3%	39.9%	28.3%	39.9%	28.3%	28.3%
Transporte Privado	18.9%	31.1%	27.2%	36.3%	27.2%	36.3%	27.2%	27.2%
Bicicleta	1.2%	3.4%	2.2%	3.4%	2.2%	3.4%	2.2%	2.2%
Transporte de personal	0.0%	3.0%	1.1%	3.0%	1.1%	3.0%	1.1%	1.1%
Taxi	0.3%	0.4%	0.9%	0.4%	0.9%	0.4%	0.9%	0.9%
Transporte escolar	2.6%	0.0%	0.5%	0.0%	0.5%	0.0%	0.5%	0.5%
Motocicleta	0.2%	1.0%	0.5%	1.0%	0.5%	1.0%	0.5%	0.5%
No especificado	1.1%	1.8%	1.7%	1.8%	1.7%	1.8%	1.7%	1.7%
Vehicular occupancy								
Caminé exclusivamente	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Transporte colectivo	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Transporte Privado	1.20	1.20	1.20	1.20	1.75	1.20	1.75	1.20
Bicicleta	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Transporte de personal	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Taxi	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Transporte escolar	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Motocicleta	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
No especificado	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Etichette di riga	Total GFA	CCD inhabitans&Users	
developed public space	43290	-	-
istitutional, educ.	76030	5848	students
creative industry	293564	14678	employees
new residential	125824	3523	residents
General Retail | CUSTOMERS	101632	16261	customers
Restaurants + F&B | CUSTOMERS		12196	customers
General Retail | WORKFORCE		1626	employees
Restaurants + F&B | WORKFORCE		2439	employees
Grand Total	**640340**	**56572**	

Masterplan land use quantities programme dated 4 Oct. 2012

In particular it is worth mentioning that the assumption of 35.71 sqm/individual on resident population is the result of assuming the size of households equal to 2.80 individuals, as suggested in official planning documents for the Poligono DUIS and a target dwelling unit size of 100 sqm derived from the master plan design quantities received.

The outcome of this is a total resident population of 3,523 units.

The household composition was interpreted as mainly couples and families of 3 or 4 components. In average, were assumed 2 adults and 0.8 children per household.

The residential population is therefore composed of 2500 adults and 1000 children in school age. Out of the 2500 adults, it was assumed that 80% will be active with half of these working within the CCD. The remaining 20% of adult population is assumed being inactive.

Children and youngsters are assumed attending school in the CCD or in its vicinity.

The Creative Industry makes allowance for almost 14,700 employees which are expected to have incomes compatible to the ones of those affording housing provided within the CCD. It is assumed that 20%, roughly 3,000 people, will be living within a comfortable walking distance thanks to the new housing provided within the master plan (it is already established that 1,000 employees will also be official CCD residents). The remaining 2,000 people will be living in areas surrounding the master plan taking advantage, in the long term, of the renovation drift of which CCD will be the catalyst.

Workforce from the retail/F&B/services and educational/institutional components are estimated in approximately 4,000 units which will mainly come from outside the CCD. The total workforce count sums up to 19,000 units, which is in line with the estimation carried out in DUIS forecasts of 20,000.

With respect to the Retail component, it is estimated that this will represent at the same time a destination for those living and working outside the CCD and a great complement for those already in the CCD as employees or residents. Cross-visits between retail and office as well as presence profiles were taken into account when determining the car parking requirements for the master plan.

Mobility needs are sized according to each category taking into account that those living and working inside CCD and its vicinities will be more keen on walking or using MOD and Public Transport rather than the private car for their daily commuting. This component is addressed as "internal Capture" and its contribution to the mobility needs of the master plan was quantified in 26% of the total amount of daily person trips estimated.

The isochrone on the right shows pedestrian catchment area within a 12 minutes range.

As displayed by the Isochrone, in a ten minute walking buffer, the whole of the master plan and a large part of its connections with the central area of Guadalajara are covered. A substantial portion of the internal trips should then be accounted as for pedestrian trips, and therefore subtracted from the vehicular trips matrices.

The external capture will mainly use motorized means of transport either collectively or individually depending on the availability of a private car within the household and the competitiveness of the public transport. The mode share percentages highlighted in the assumptions panel already account for this distribution between internal and external capture and are applied to the whole of the population estimated person trips (112,100 person trips/day).

Hourly values of person trips were estimated for both the AM and PM peaks:

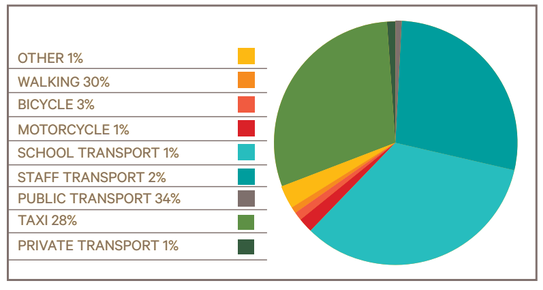
- AM - 20300 person trips/h of which 79% inbound
- PM - 26000 person trips/h of which 34% inbound

Translated into vehicle trips, the additional load on the road network is quantified in:

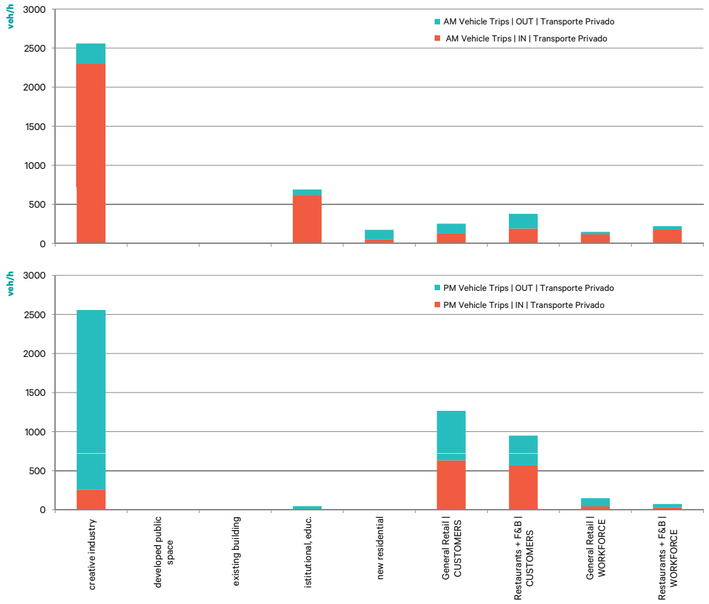
- AM - 4420 veh/h of which 81% arriving and 19% leaving CCD
- PM - 5258 veh/h of which 29% arriving and 71% leaving CCD

In a ten minute walking buffer, the whole of the master plan and a large part of its connections with the central area of Guadalajara are covered. A substantial portion of the internal trips should then be accounted for as pedestrian trips.

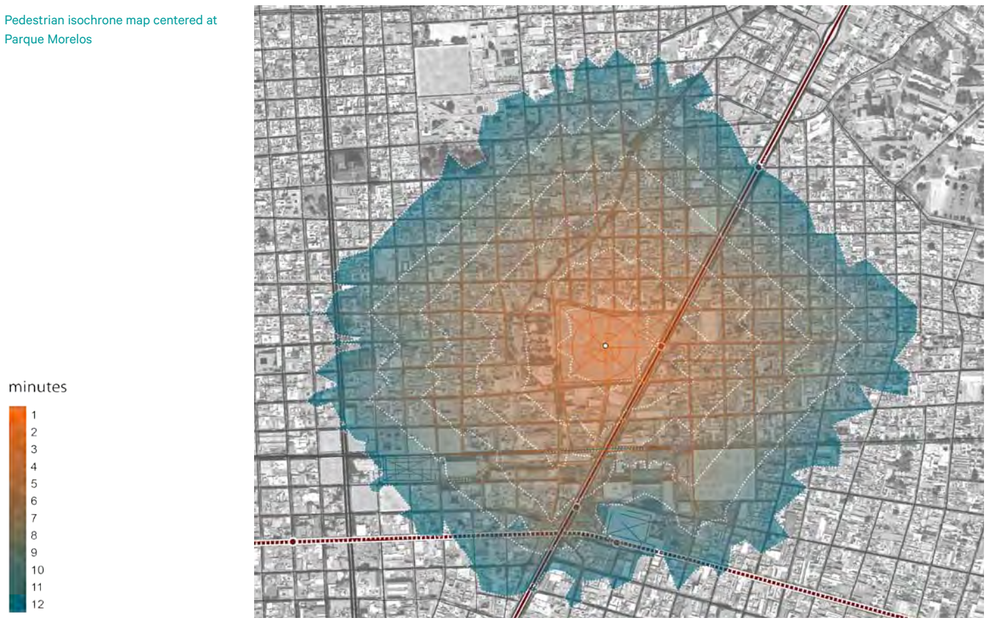
Overall person trips mode share for trips within CCD masterlpan in Phase 3



Vehicular trip generation for the CCD masterplan in Phase 3



Pedestrian isochrone map centered at Parque Morelos



17. 5. 9
Trip Distribution

In the previous paragraph it was stated that a substantial portion of the internal trips should then be accounted as for pedestrian trips, and therefore subtracted from the vehicular trips matrices.

The external trips, e.i. trips relating the master plan with the other areas in town are distributed in a way proportional to the trip-ends of the O-D Matrix of scenario 3.

Modelling-wise in order to reflect the parking strategy envisaged for the master plan, vehicular trips origin and are destined at car park facilities which are spread across the CCD to represent the parking structures as planned. Of course the model remains a simplification of the reality, therefore the proposed car park layout might not represent the full picture of the project's parking distribution, still ensuring its functional aspects.

Car parks are associated to all traffic zones representing CCD thus enabling drivers to perceive all parking facilities in the area as suitable to reach their final destination within CCD. This is exactly how the strategy should work once implemented thanks to the reliability of the digital technologies.

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micro-simualtion moel parking distribution

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17. 5. 10
Scenario 4

In this paragraph two different alternatives which share the full implementation of CCD are shown. These are:

Scenario 4A : base traffic of Scenario 2 plus that generated by Polygon 1,2 and 3 that involves a total traffic value of 30429 vehicles.

Scenario 4B: it contains the traffic of Scenario reduced of 15 % to account for polices to reduce city traffic (25865 vehicles)

Both the Scenarios keep the same configuration as previous ones.

Focusing on Scenario 4A, traffic growth produces a very significant decrease of the network performances, in particular in terms of Mean Speed that testifies a system that operates at congestion. The output of Scenario 4B confirms the efficiency of the polices in terms of performance of the entire road network.

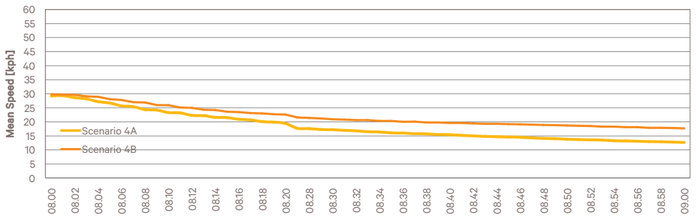
The reduction of 15% in traffic volumes across the entire area, not only the CCD, and the good performances associated to such a scenario, witness that the road network would benefit very significantly from the implementation of any policy that over a period of 10-12 years manages to reduce traffic entering in the city centre.

Policies of this kind are being implemented in several cities of the world and fid their apex in road pricing measures. It is important to highlight though that any policy aimed at restricting access by private car in selected areas of urban contexts must be accompanied by improvement and upgrade of the public transport network.

It is clear though, that 30,000 veh in the peak hour are over the bearing capacity of the road network of the DUIS area.

CCD generates and attracts roughly 15% of such traffic and certainly it is imperative that CCD traffic be subject to dissuasion of the use of private car as tight as possible, however, the specific conditions of the road network of Guadalajara suggest that specific measures must be taken for the through traffic which should be re-routed elsewhere. For this very specific reason, strategies such as road pricing seem particularly effective.

The road network would benefit very significantly from the implementation of any policy that over a period of 10-12 years manages to reduce traffic entering in the city centre.



	Performance								
Scenario	avg. travel time [sec]	tot travel time (s)	tot veh distance (m)	vehicles assigned	mean veh speed [kph]	tot. vehicle travelled distance	tot. travelled time [h]	matrix dimension	assigned vehicle vs n° of veh. in matrix
Scenario 4A	385.1	10954229	36231451	26544	12.7	36231	3043	30429	87%
Scenario 4B	274.3	7164154	33927774	24848	17.7	33928	1990	25865	96%

	Traffic (veh/h)				
Scenario	Herrera y Cairo	Joaquin Angulo	San Diego	Juan Manuel	Av. Independencia
Scenario 4A	617	489	1004	697	636
Scenario 4B	692	373	928	634	885

	Performance								
Scenario	avg. travel time [sec]	tot travel time (s)	tot veh distance (m)	vehicles assigned	mean veh speed [kph]	tot. vehicle travelled distance	tot. travelled time [h]	matrix dimension	assigned vehicle vs n° of veh. in matrix
Scenario 5A	344.7	10181226	37450938	27778	14	37450.94	2828.12	30429	91%
Scenario 5B	244.8	6528897	35286709	25652	20.1	35286.71	1813.58	25865	99%

Scenario

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17. 5. 12

Scenarios Comparison

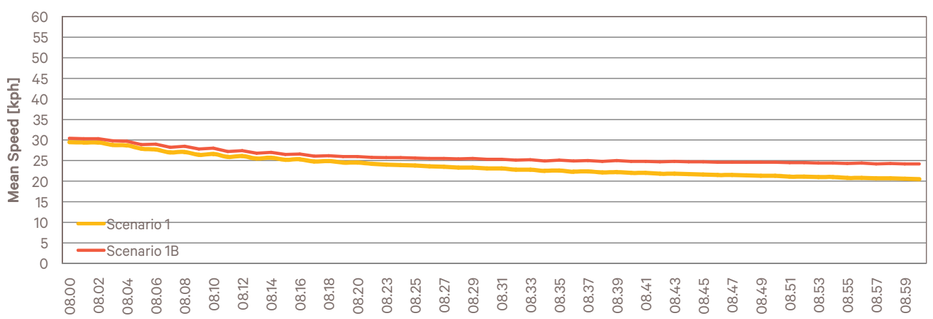
17. 5. 13
Sensitivity Test 1: Scenario 1B

The first sensitivity Test is made to evaluate how Public Transport affects the road network. Scenario 1B simulates traffic condition without PT. The roaod network and the matrix are the same of Scenario 1 (21372 veh/h).

Table below shows 18% increase of Mean Speed for Scenario 1B.

This means that the effect of Public Transport arrangements weighs 18% on road network speed. That is the margin of improvement to road network speed and travel times by acting on Public Transport rationalization policies within DUIS.

The effect of Public Transport arrangements weighs 18% on road network speed, this therefore being the margin of improvement by acting rationalization policies within the CCD and more in general the DUIS



Scenario	Performance								
	avg. travel time [sec]	tot travel time (s)	tot veh distance (m)	vehicles assigned	mean veh speed [kph]	tot. vehicle travelled distance	tot. travelled time [h]	matrix dimension	assigned vehicle vs n° of veh. in matrix
Scenario 1	228	5067983	28219029	21362	20.5	28219	1408	21372	100%
Scenario 1B	195	4264592	28160024	21255	24.2	28160	1185	21372	99%
Scenario 1 vs 1B	-14%	-16%	0%	-1%	18%	0%	-16%	0%	-1%

17. 5. 14
Sensitivity Test 2: Scenario 6

The second Sensitivity test, Scenario 6, has the purpose of verify the consequences in terms of performance of removing the overpass between Av. Hidalgo and Calzada Independencia starting from the properties of Scenario 5A:

Demand 30429 vehicles

Road network with changes proposed by MIC

This Scenario produces significant decreases in performance in terms of Mean speed and, above all, for number of vehicles assigned to the network(-10%).

It suggests that in this situation the intersection controlled by traffic lights is not able to handle such high value of traffic, producing excessive queuing.

Based on model outputs, it is recommended that city-wide strategies aimed at reducing traffic volumes through the city centre are implemented prior to undertake the downgrading of the Hidalgo flyover.

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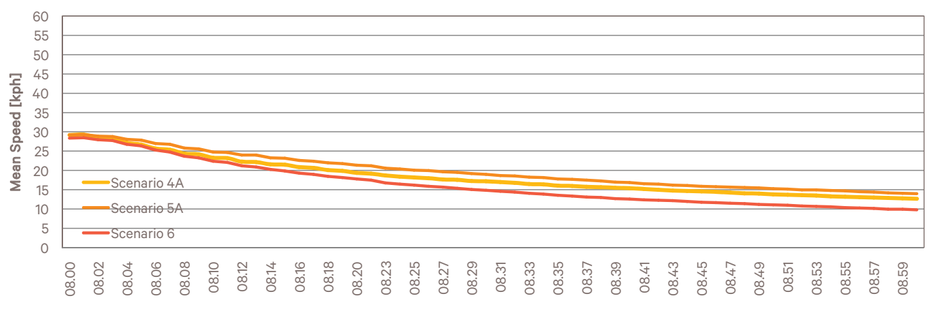


Scenario	Performance								
	avg. travel time [sec]	tot travel time (s)	tot veh distance (m)	vehicles assigned	mean veh speed [kph]	tot. vehicle travelled distance	tot. travelled time [h]	matrix dimension	assigned vehicle vs n° of veh. in matrix
Scenario 4A	385.1	10954229	36231451	26544	12.7	36231	3043	30429	87%
Scenario 5A	344.7	10181226	37450938	27778	14	37450.94	2828.12	30429	91%
Scenario 6	461	12117867	30393165	24200	9.8	30393.16	3366.07	30429	80%
Scenario 4A vs 6	20%	11%	-16%	-9%	-23%	-16%	11%	0%	-9%
Scenario 5A vs 6	34%	19%	-19%	-13%	-30%	-19%	19%	0%	-13%

17.6.

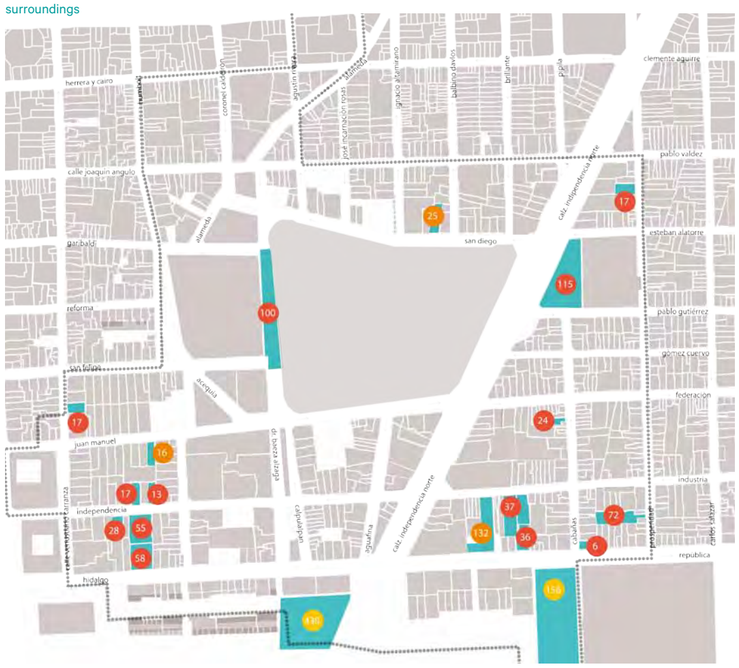
The CCD parking strategy

17.6.1. Parque Morelos: parking today

Directly related to the current car oriented scenario, the parking condition in the CCD master plan area, and more in general in the city centre, heavily affects the general urban quality and living conditions. Both off street and on-street parking play a role in the relation between traffic and pedestrian environment. On one side, as discussed when referring to the wide scale, providing destination car park in the central areas encourages traffic. On the other side, parking needs space and the dense and fine grained distribution of parking areas has physically changed the face and the shape of Guadalajara city centre. There are currently several types of parking solutions. They range from the ubiquitous on-street parking, often illegal and perceived by the locals as a problem to be solved, to the off-street parking facilities, generally above ground structures in filled in the urban fabric. There are also other solutions, especially for the private parking, that have become a specificity of the architectural context. One of these is the presence of diffused small parking lots of maybe ten parking bays, that break up the continuity of the plot, exploiting - or encouraging - urban blanks in between the buildings. Another, even more peculiar and untangled to the local context, is the conversion of the residential buildings' ground floor into private garages. This latest solution greatly affects the livability of the roads and totally changes the environment at the foot of the buildings. Moreover, despite being mostly caused by the unsafe condition for those parking on- street, it of course plays a contradictory role in generating the very same unbearable environment that is at the base of its introduction. In order to frame the existing parking situation, a preliminary estimation of the currently existing parking facilities has been carried out, based on the info retrieved from the Guadalajara municipality, as well as from on site observation and photographic material. The focus has been oriented in particular on the on-street spaces, which have been quantified for the CCD site in 1750 parking bays, including fee, free, reserved and illegal parking. This data have also been used to assume which share of on-street parking was to be considered available for the future master plan and, due to the absence of any surveyed data regarding the parking occupancy on site, the different percentages applied to each one of the existing parking regimen, lead to a conservative 25% on the overall offer.

Parking needs space and the dense and fine grained distribution of parking areas has physically changed the face and the shape of Guadalajara city centre.

Off- street parking facilitities currently available in the Parque Morelos surroundings



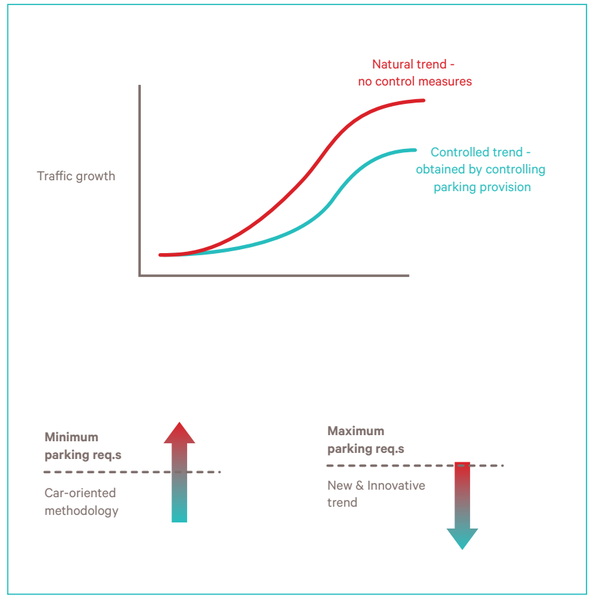
On- street parking currently available in the Parque Morelos surroundings

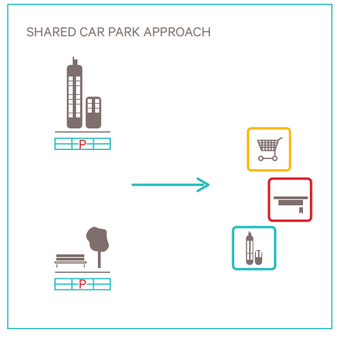
17.6.2. Parking strategy

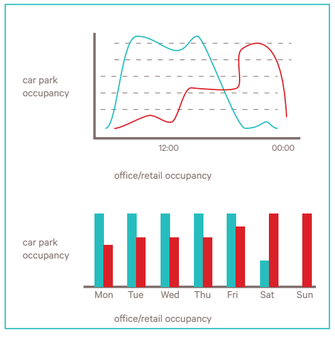
As a general rule, the more parking spaces the more traffic. This axiom has been proven true in many years of urban evolution and often lead, at least from a space occupancy standpoint, to the victory of car on people. The parking provision can be used to tune the traffic volumes attracted by an area and, as seen looking at the many international best cases previously described, many cities worldwide have already started applying this strategy to reduce the number of cars that access daily the most central and neuralgic parts of town. Some of the strategies that have been mentioned for the urban scale, such as for instance setting a maximum provision instead of a minimum one, could have their first application in the CCD, which will become a point of enucleation for this innovative and sustainable approach to mobility. The concept of public or municipal parking can also become a part of this vision, achieving a potential reduction of the on-site parking demand. In this frame, the proposed master plan parking strategy defines a dedicated parking provision for the residential function only, even if the overall number of residential car parks is envisaged as strongly reduced compared to the original local regulation. The greater intervention with regards to the parking provision involves the other commercial functions, as well as the institutional and educational ones. The parking demand associated to these uses will in fact rely on a portion of the on-street provision, as well as on a set of shared parking structures evenly scattered across the site, so to guarantee a high pedestrian accessibility level as well as a good coverage of the whole master plan. The fundamental advantage related to this approach, that unbundles the car park from the land use function, is that of allowing the full exploitation of the existing spaces, thanks to the difference in the occupancy peaks between different functions. This principle can be applied both on a daily and weekly basis. As a result, every parking space in the CCD, no matter if public or privately owned, would work as a public space and anybody could park in it just paying the requested fee. The parking pricing is in fact the other basic ingredient of the CCD parking strategy. The idea that there is no cost associated to parking is one of the most diffuse misunderstandings of the car era and, especially when referring to the relation between a company and its employees, the fact of having free parking at destination plays a crucial role in the choice of the mode of transport. The management of the on-street provision will of course entangle with these guidelines. The high number of possible scenarios related to the different types of investors and companies that will move to the CCD in the years to come will call for a level of flexibility and adaptivity that is guaranteed by the geographical distribution of the parking structures, by the strategic guidelines of shared parking facility as well as by the digital management system envisaged for the master plan. These will in fact allow for instance to easily diversify the management of just sectors of car parks or even of whole structures, making them completely private and separated from the shared provision if needed.
A further important evolution of the proposed parking demand analysis would be based on the outcomes of specific parking surveys. These would allow to retrieve informations on the residual capacity of on and off-street existing parking facilities.

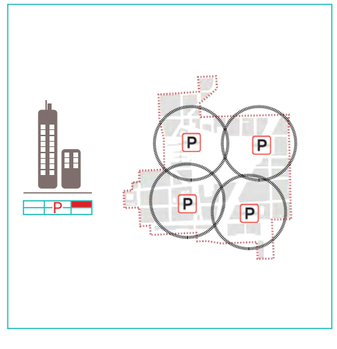
Shared parking facilities will allow to optimise the parking efficiency by maximizing the occupancy of the available parking spaces throughout the day, exploiting the difference in the occupancy peaks depending on the land use.

- wide scale strategies
- masterplan strategies
- specific masterplan strategies









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17.6.3. Parking generation

Following the same set of assumptions which led to the determination of the trip generation table, the parking provision was assessed while attempting to minimize the overall amount.

The first goal is that of reducing the number of car parks required by the master plan, still of course guaranteeing a provision which remains consistent with the context. How this has been achieved for the CCD is here described through the definition of the main assumptions applied in deriving the master plan parking provision.

- The internal capture for the site is 26% in relation to the total daily amount of person trips produced by the CCD. Internal trips will mainly occur on feet or by means alternative to the private car, hence will not need parking. Internal trips are constituted by trips between, residential and creative industry, between creative industry and retail, between residential and institutional/educational facilities, between residential and retail.
- The parking provision for the creative industry and for the workforce component of retail and F&B land uses is sized against the number of employees arriving by car (having applied the respective mode share highlighted in the trip generation assumption table in previous chapter)
- The parking provision for the educational land uses is assessed against faculty members. A ratio of 1 in 20 attendees is assumed.
- The parking provision for the developed open space is nihil assuming the usage of the open space is an ancillary use of the other primary presence purposes.
- Retail and F&B customer parking provision is assessed against the number of vehicle trips expected during the peak hour as per the trip generation process reduced by factors taking into account both the cross visit mentioned above as well complementary differences in occupancy profiles of retail and office component. Cross Visit factors range between 20% (general retail vs office) and 50% (F&B vs general retail and office). Occupancy Profile Optimization factors range between 10% and 25%.

The logic behind the prosed parking management strategy founds on the concept shared parking among land uses rather than strictly enforcing segregation as traditionally required by norms and regulations.

The parking provision is therefore calculated in relation to macro-zones highlighted in the navigator on the right hand side, however it is deemed that parking facilities across the entire masterplan. given its dimension, ,ay effectively serve the entire area.

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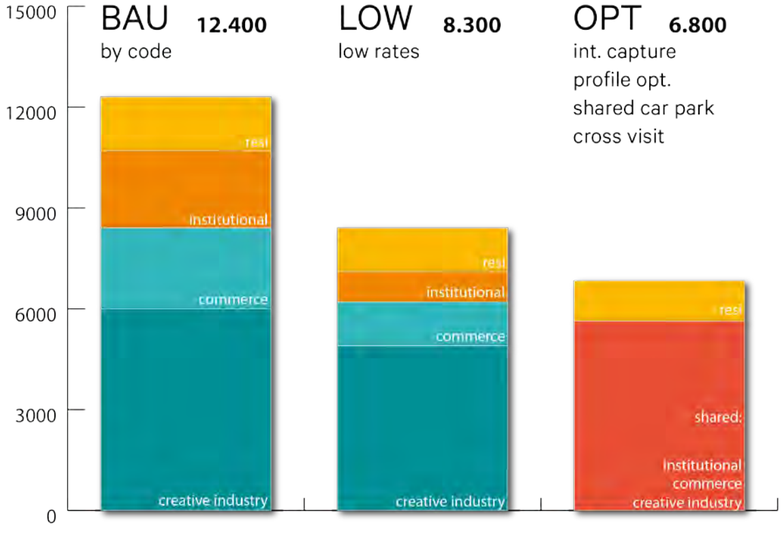
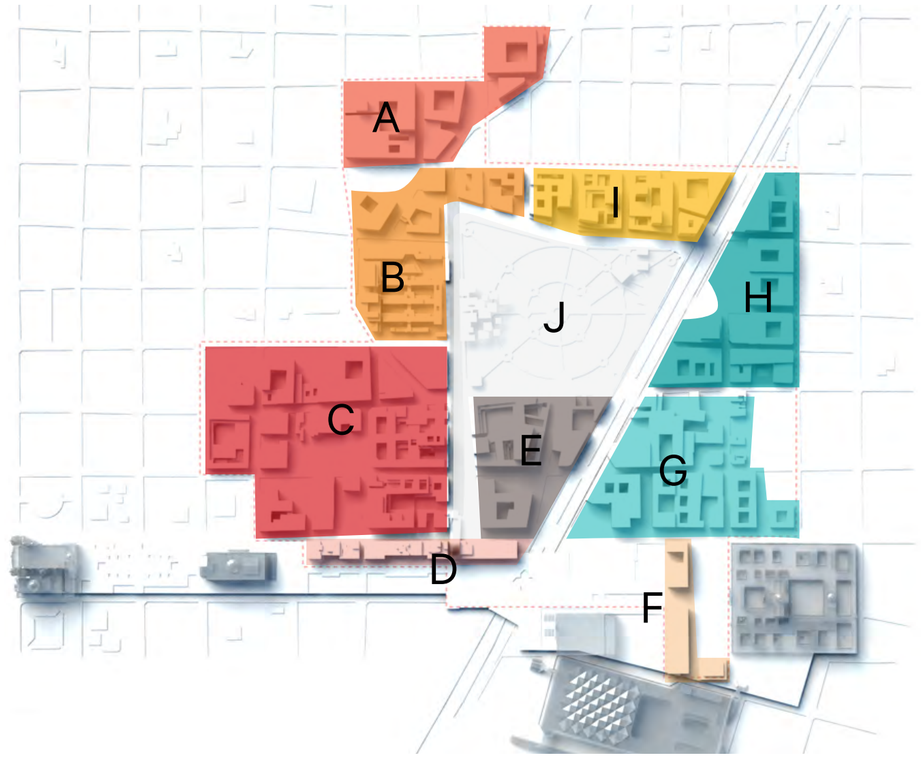


Macro-zoning navigator



Masterplan parking provision estimate for phase 1 and by macro-zone

	A	B	C	D	E	F	G	H	I	TOT
Creative Industry | Office + Production	0	0	545	0	0	0	0	0	0	545
Commercial | Retail, Rest, Service + Hotel	0	8	204	0	114	0	0	0	0	326
Institutional	0	121	0	0	99	0	0	0	0	220
Developed Public Space	0	0	0	0	0	0	0	0	0	0
Residential	0	2	68	0	38	0	0	0	0	108
Grand Total	0	131	818	0	251	0	0	0	0	1200

Masterplan parking provision estimate for phase 3 and by macro-zone

	A	B	C	D	E	F	G	H	I	TOT
Creative Industry | Office + Production	550	320	776	12	205	15	547	397	606	3428
Commercial | Retail, Rest, Service + Hotel	0	8	441	256	172	223	300	423	0	1822
Institutional	3	121	69	0	99	0	0	0	0	292
Developed Public Space	0	0	0	0	0	0	0	0	0	0
Residential	222	130	300	0	48	0	252	305	0	1258
Grand Total	775	579	1586	267	524	238	1100	1126	606	6801

17.6.4. Parking distribution

OFF-STREET PARKING

Describing in greater detail the CCD master plan's parking system, the maps in these pages show the proposed parking facilities and on-street parking distribution in the project's final phase. Following the principles described in the strategy overview, a series of underground and above ground parking structures are evenly scattered across the site, both in correspondence of built plots and under public spaces such as the Rambla. The aim is that of providing a good coverage of the masterplan's site and therefore a comfortable pedestrian accessibility to all facilities from every zone of the precinct. Thanks to the scale of the site area and to the deriving good walkability between each and every point of it, a great flexibility in the parkings' usage is guaranteed, most of them being potentially accessible from many parts of the master plan. This characteristic, along with the digital parking management and way finding system that will be described in paragraph 7, will allow for a high flexibility of the users' redistribution among the parking structures, maximizing the occupancy and improving the accessibility. This solution will also allow to satisfy the parking demand of those macro-zones that for architectural or optimization reasons might have less parking structures on site, thanks to the possibility of relying on parking areas located in nearby zones but still included in a comfortable pedestrian buffer. Moreover, the flexibility level will support and improve the overall system's functionality during the masterplan's phasing, allowing for a constant occupancy redistribution. Compatibly with the locations available, the parking areas and the access points are positioned so to minimize the need of vehicular penetration within the central parts of the master plan, when accessing the car parks. With regards to the phasing, the solution provided allows to change the construction strategy depending on the master plan needs. It has been described in the strategic approach how guaranteeing a high level of adaptability in the parking system is an important target, considering the nature of the Ciudad Creativa Digital and its many possible evolution blends. The parking layout of the four office blocks located along San Diego to the north of Parque Morelos is a good example of how the present proposal could be adapted to the users and market's needs. Two possible extreme scenarios: four corporate office buildings or several small companies sharing the four office towers. Each possibility might require a different configuration of the parking areas below, especially if the single public car park slab doesn't match the privacy or security needs of the building's owner. Moreover, the construction phasing of the plots above will influence the construction of the car parks below and the images in this pages show how an incremental construction of both the car park and it success points could be envisaged.

ON-STREET PARKING

The second important element of the parking framework is the on-street parking. For instance, while it is recognized how the presence of a controlled share of on-street parking can improve and even sustain the activity along a street, the extreme condition of omnipresent cars parked along the road, both legally and illegally, is to the detriment of the general quality of the urban space. On-street parking in fact, when regulated in order to guarantee a sufficiently dynamic turnover of the occupancy, would make the street environment more active, supporting the activities at the foot of the buildings and indirectly increase the passive security. On-street parking can also be used as an instrument for traffic calming. The reduction of lateral sight related to the presence of on-street parking induces car drivers to slow down. All this said, it has clearly emerged from the round tables organized in the CCD areas with local residents, potential employees and investors as the current situation of the on-street parking is perceived as negative for the quality of the space. The plan here proposed shows the modifications envisaged to the existing situation, which basically rely on two principles:

- the reduction of the number of parking lanes
- the creation of parking pockets on the pavement's side alternating landscape and parking bays

The first action will free-up space in the road section, that will become available to improve the pavements' size or to locate a bike lane; the second solution, while partially reducing the number of parking spaces available, will provide a higher urban quality and wider pavement's sections where needed, such as for instance in correspondence of the pedestrian crossings. The overall number of on-street parking spots, while lower compared to the current configuration - will be consistent with the proposed masterplan parking provision: the conservative share assumed to derive the on-street parking related to the master plan will leave less but still enough spaces available for other users related to the rest of the neighbourhood needs, especially considering that the on-street parking will be fee parking. This, in association with a carefully tuned pricing strategy - that will consider special agreements for the old and new residents, and the enhancement of the masterplan accessibility on public transport - will reduce the overall demand of on-street parking, especially of those that were using it for long stay periods and that will be, when still travelling by car, redirected to off-street facilities.

The evenly scattered parking facilities will improve the system's accessibility and efficiency, while the calibration of the on-street parking will support an active and livable human environment.

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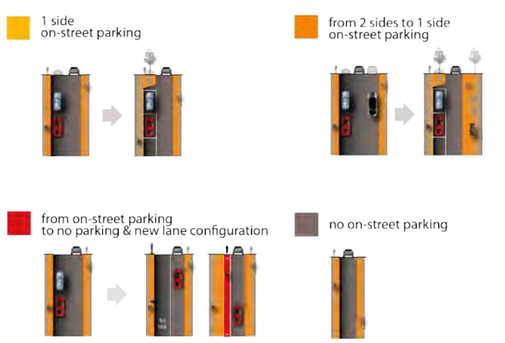

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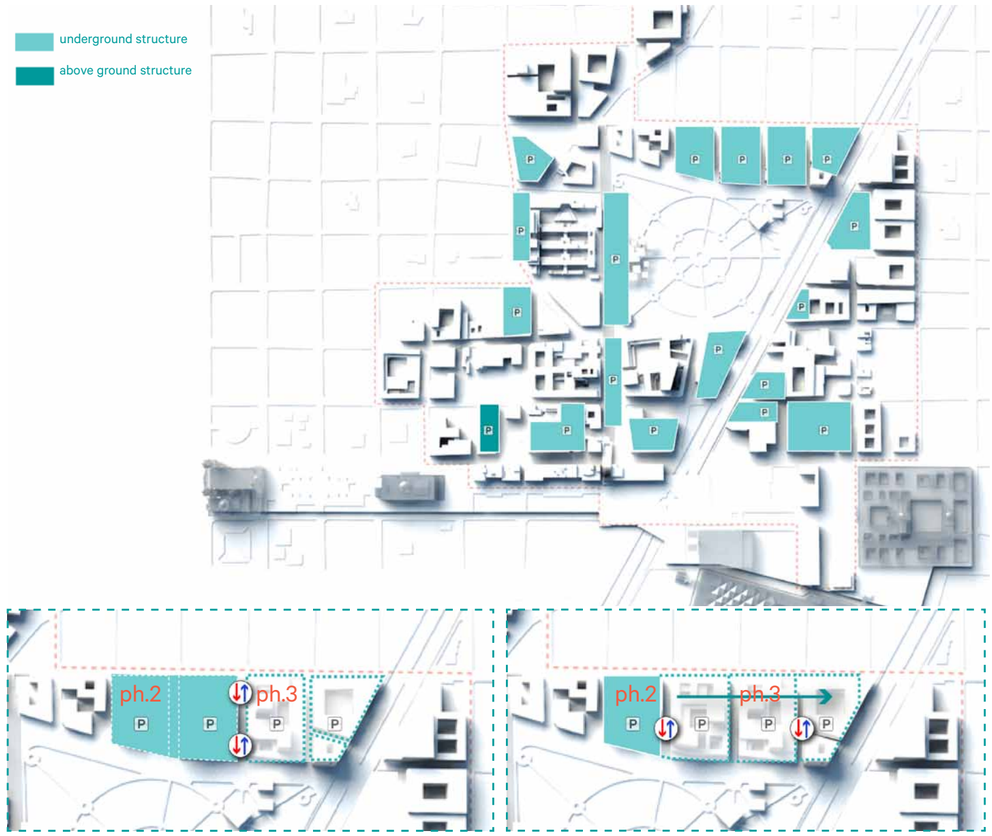
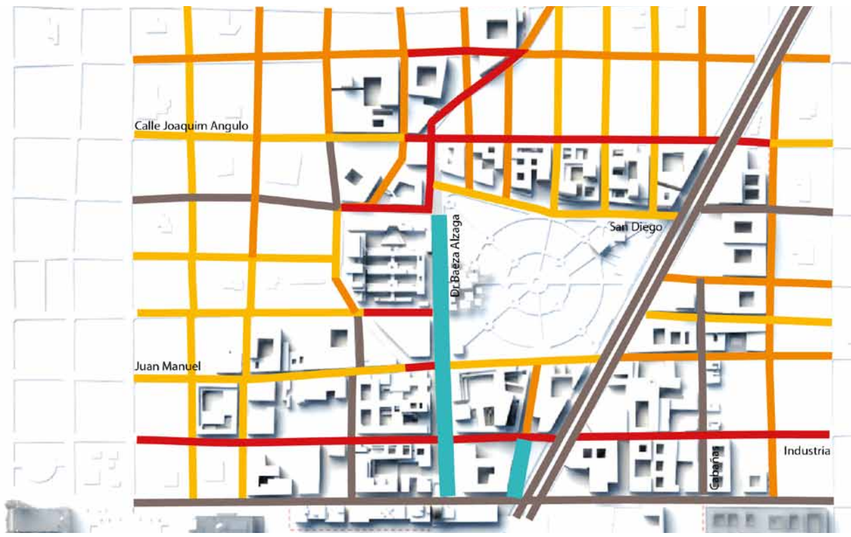
masterplan off-street parking facilities

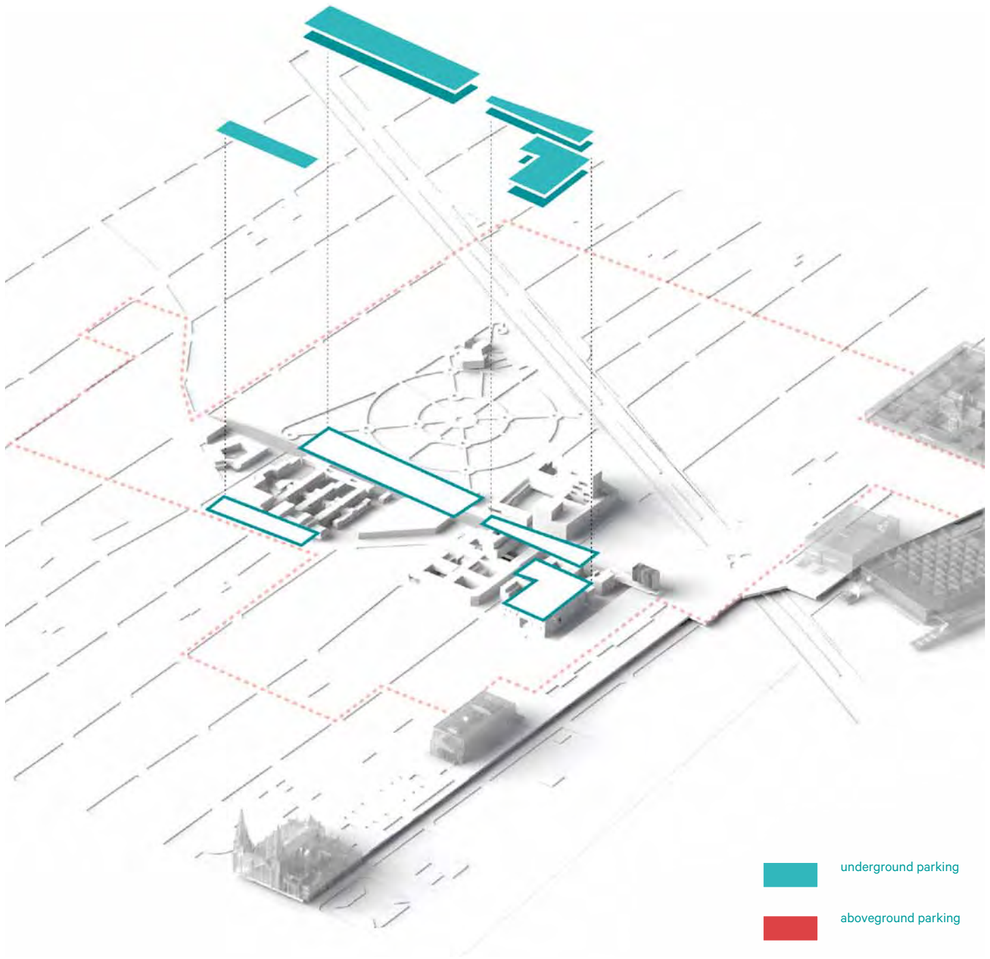


masterplan on-street parking interventions



The distribution option shown in these pages refers to the overall master plan parking demand, without considering any reduction based on the possible use of residual capacity of existing facilities. This in order to illustrate the feasibility of the scenario in which all parking spaces have to be build along with the master plan, making it totally self-sufficient from a aprking provision standpoint. The car parks shown in the images are the one shared among all the comemcial andistitutional functions. With regards to the residential function, 3 parking levels the size of the residential lots' footprint are sufficient to host all the required parking spaces.

parking levels required in ph.1



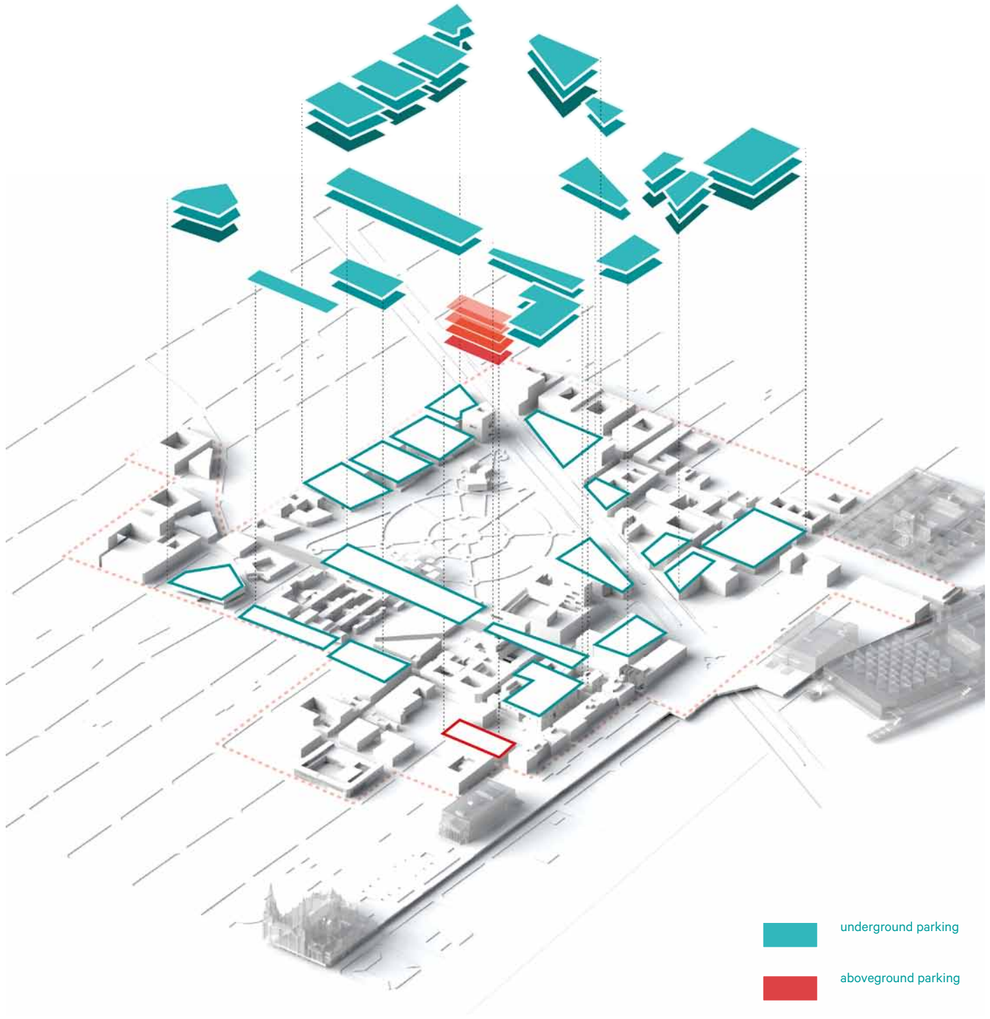
On- street parking offer | phase 3

On Street Parking	Potential Residual Capacity					Demand	Ratio
FREE	25%	78	475	20	122	vs 326	37%
IRREGULAR	0%	29		0			
RESERVED	0%	165		0			
WITH FEE	50%	203		102			

On- street parking offer | phase 1

On Street Parking	Potential Residual Capacity					Demand	Ratio
FREE	25%	1141	1746	285	442	vs 1822	24%
IRREGULAR	0%	54		0			
RESERVED	0%	237		0			
WITH FEE	50%	314		157			

parking levels required in ph.3



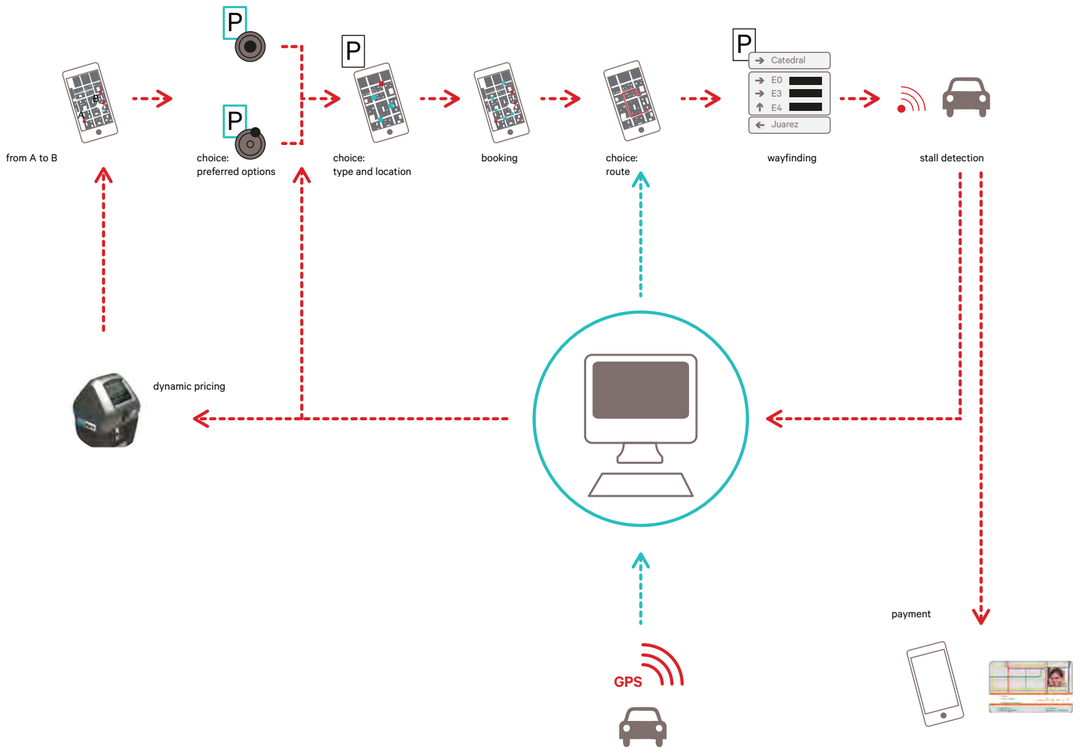
17.6.5. Digital parking management system

One of the pilot programs envisaged for the CCD is the implementation, starting with phase 1, of a digital parking management system for the master plan. This initiative can be definitely seen as a complement to the overall digital mobility platform and is to be intended as coordinated with the transit control system. Interacting and accessing the system through smart terminal (private such as the smart phone or the laptop, or public as the smart totem on street), the user can input his travel path and the system will return a series of parking options, characterized by a different generalized cost, be it the fee, the location or the type of facility. Once chosen the desired option, the system could allow booking operations and will lead the driver to the parking spot by means of a routing application and relying on the master plan's wayfinding system. Both on-street and off-street parking spaces will be part of the overall digital system. Their occupancy will be monitored in real time through different types of sensors (magnetic and optic) and the data collected will allow to set fees' conditions, the parking access control, the way finding.

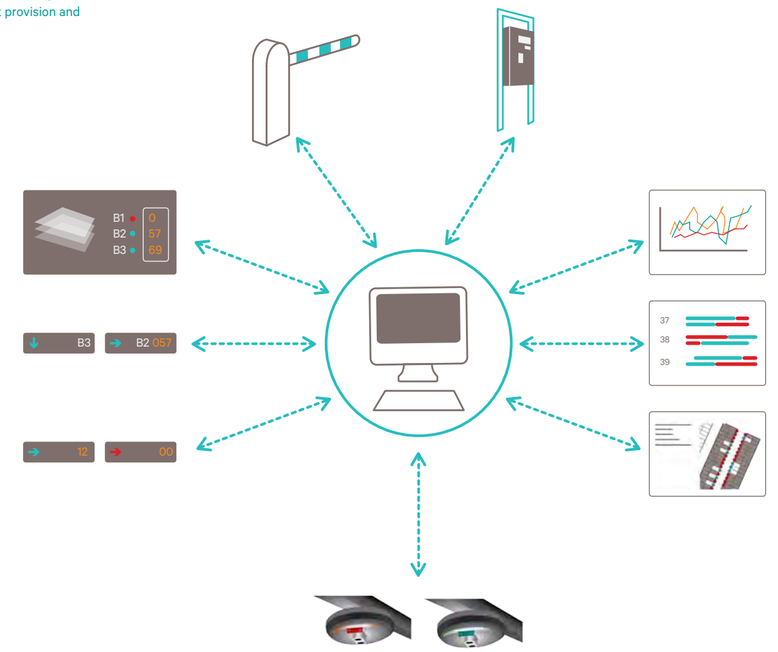
Both on-street and off-street parking will be part of the overall digital system. Their occupancy will be monitored in real time through different types of sensors and the data collected will allow to set fee conditions, parking access control, way finding.

More in detail, within the car park structure, the single stall detection systems monitors every single parking stall, informing the software in real-time if the spaces are free or occupied. A light located above each parking space indicates the availability to visitors. There are two types of systems: ultrasonic, where the occupancy of parking spaces is monitored through the emission of waves ultrasonic, as well as optical, where the monitoring of parking is carried out by cameras. The lights located above the parking spaces can also be used to reserve parking space to a particular type of user, or provide parking for the disabled. The lights increase greatly the visibility within the parking, and increase the level of service leading the user to a place immediately available. As mentioned, the other fundamental aspect of the parking digital management system is the possibility of applying a dynamic pricing strategy. It has been described how the parking provision is used in the Ciudad Creativa Digital as an instrument to regulate the vehicular attractiveness. The possibility of changing the fee depending on the occupancy - and therefore on the desirability - of a specific parking spot allows a continuous fine tuning of the offer versus demand relation, making the parking provision even more powerful in disincentive or redirecting the vehicular activity. The phasing out of the digital parking management system will require the control of the off-street and on-street offer from the very beginning. This also due to the necessity of regulating the on-street parking in order to support the satisfaction of the overall masterplan parking demand. The dynamic pricing is therefore definitely part of the initial steps of the pilot program, while the fine tuning of the several possible actions available to the users can be phased out depending on the evolution of the master plan's infrastructure and data collection.

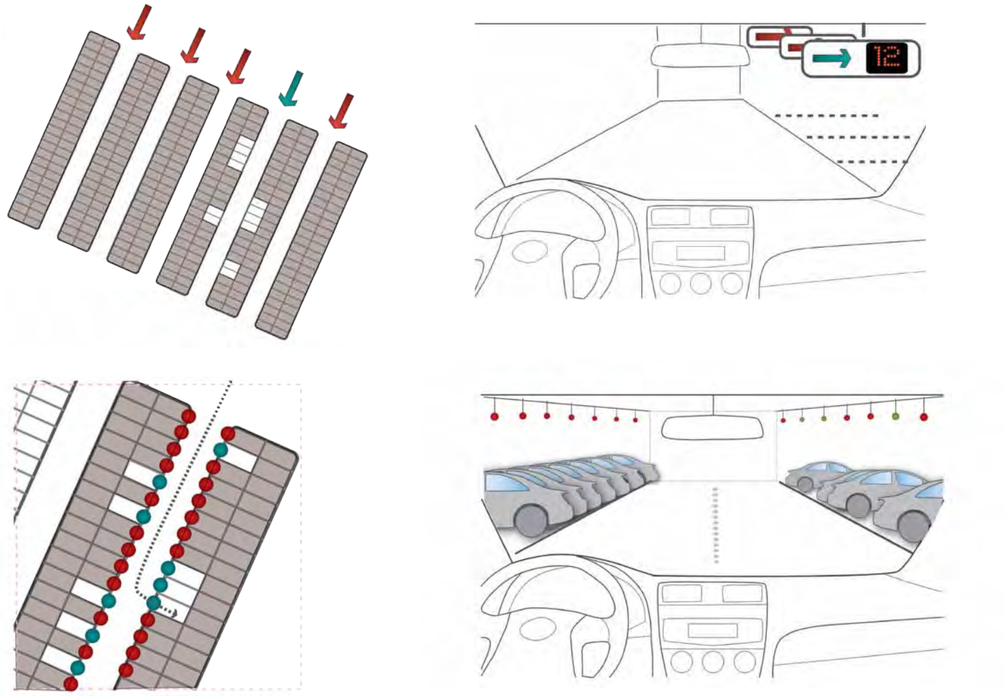
The user and the digital parking managemetn system



Elements of the digital management system for off-street provision and wayfinding



Elements of the single stall detection system for parking structures



17.6.6. Way finding

The way finding system is a fundamental element of the overall master plan parking strategy. It improves the sense of arrival experience by providing a smooth and safe direction to the parking destination. Moreover, through the parking management system, it allows to increase the parking occupancy and therefore its efficiency. The way finding systems are based upon three main signs typologies, each one of which has a specific function. The orientation signs are the ones that refer to the wider area and allow the traveller to get oriented, to make a "travel plan". The direction signs directs the traveller along the way, while the destination, location or Identification signs indicate the destination of travel as well as some additional information on it.

MASTER PLAN'S SIGNS SYSTEM

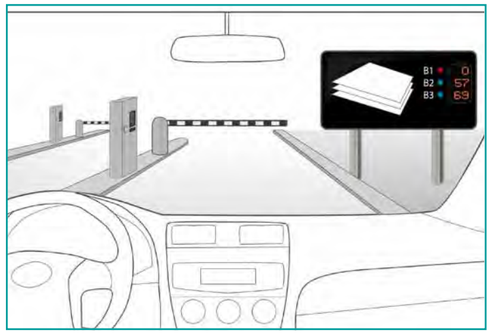
The way finding directs the driver starting from the master plan's main access axes - Calzada Independencia, Hidalgo, Juan Manuel, Esteban Alatorre, Cale Joaquín Angulo - describing the location of the main buildings and parking facilities. The second layer of signs is composed by direction panels, both static and with variable message, so to allow the driver to decide his final destination, based on parking availability data. Lastly, a variable message destination panel will be located at each car park structure, so to highlight the parking availability, specified level by level.

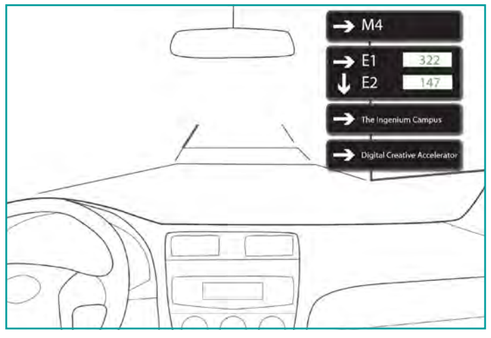
INSIDE THE CAR PARK: THE VARIABLE MESSAGE PANELS

As discussed, the real-time information relating to the occupancy of each parking space can be used to guide the user from the entrance of the parking lot to a parking space that is available. A set of variable message signs, remotely controlled by means of a dedicated software, directs the visitors in and out the parking structure, optimising the parking management and vehicular circulation inside. The previously mentioned destination variable panel, located at the entrance barrier, indicates the availability of spaces on each floor or parking itself. At each level of stopover, it is indicated the exact availability of car park spaces on the floor, as well as each drive lane within the parking area is equipped with variable signs that indicate the number of remaining places. Thanks to this system, users do not search for parking but simply follow the directions to a free parking space. Moreover, given the information on residual parking capacity, the management system can automatically control the barriers, closing them when the car park is nearly at capacity.

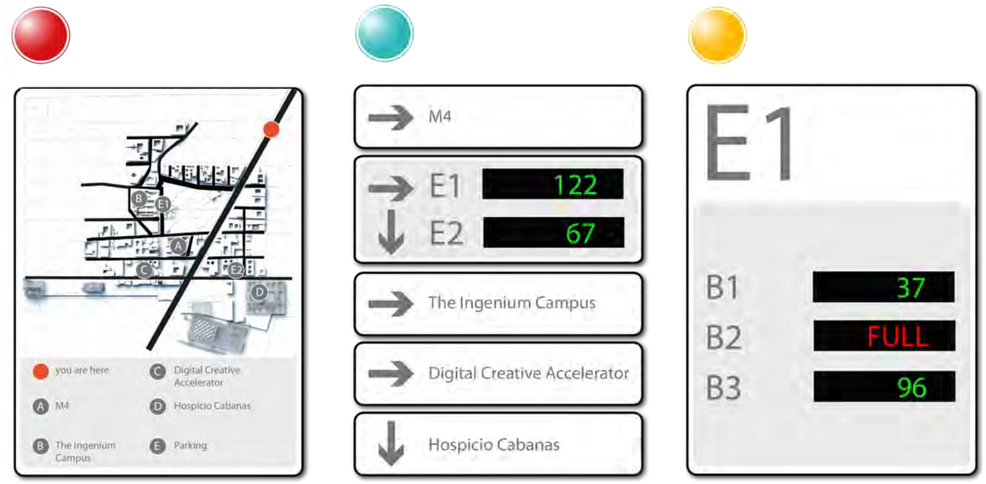
The way finding system is a fundamental element of the overall master plan parking strategy that improves the sense of arrival experience and allows to increase the parking occupancy and efficiency.

Variable message panels

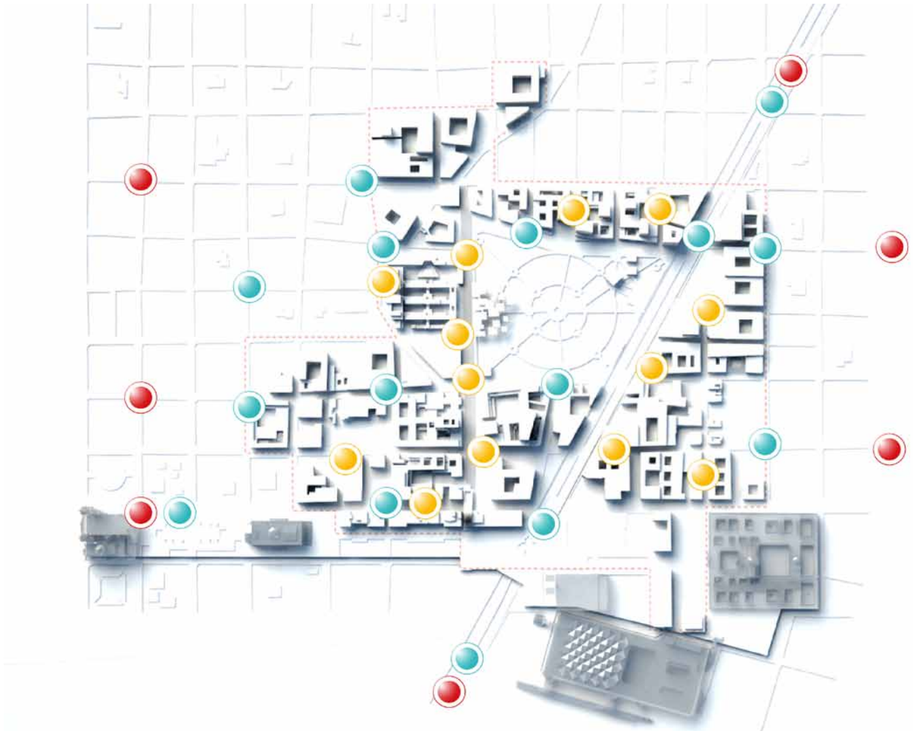




Wayfinding: the sign typologies



the CCD way finding location map



17.7.

Transit to the future

17.7.1. Transit to the future

The new digital platform will allow all types of transport to be systematized, linking vehicles, users and providers, creating a real management and interface system that can control and simplify any operation related to the trip, from planning to payment, optimizing waiting times and distance to travel.

The user will be able to gather real-time information about the CCD's public transport systems (Tren Ligero/BRT, bus, MoD and car-sharing). It will be possible to check the fleet conditions, the waiting times, the potential alternative routes and costs staying at home or directly from the interactive kiosks on the street. It will be also possible to input the origin and required destination and have the system propose the best route.
The unified management system will be able to create a personalized trip solution, combining the different modes of transport.
The potential of such coordination consists in the possibility of planning for instance a bus trip, followed by an availability check of MoD vehicles, and maybe a subsequent booking. Information, planning, and booking/paying at once.
This will be possible with collective interface systems (panels, bus-stop and info points) and with personal devices (from smart phones, to tablets and personal computers).

From the provider's standpoint, the integrated IT platform would allow a radical improvement and optimization in managing the systems. In a frame where public transport includes in its fleet sustainable electrical vehicles, the issue of battery charging is a major one. Knowing each single vehicle's location, the state of the network and even the daily users' demand curves will allow planning the fleet's recharge in the best way possible. Maintenance, scheduling and rerouting are other plus that would be provided by the digital management system.

The new digital platform will allow all types of transport to be systematized, linking vehicles, users and providers, creating a real management and interface system that can control and simplify any operation related to the trip.

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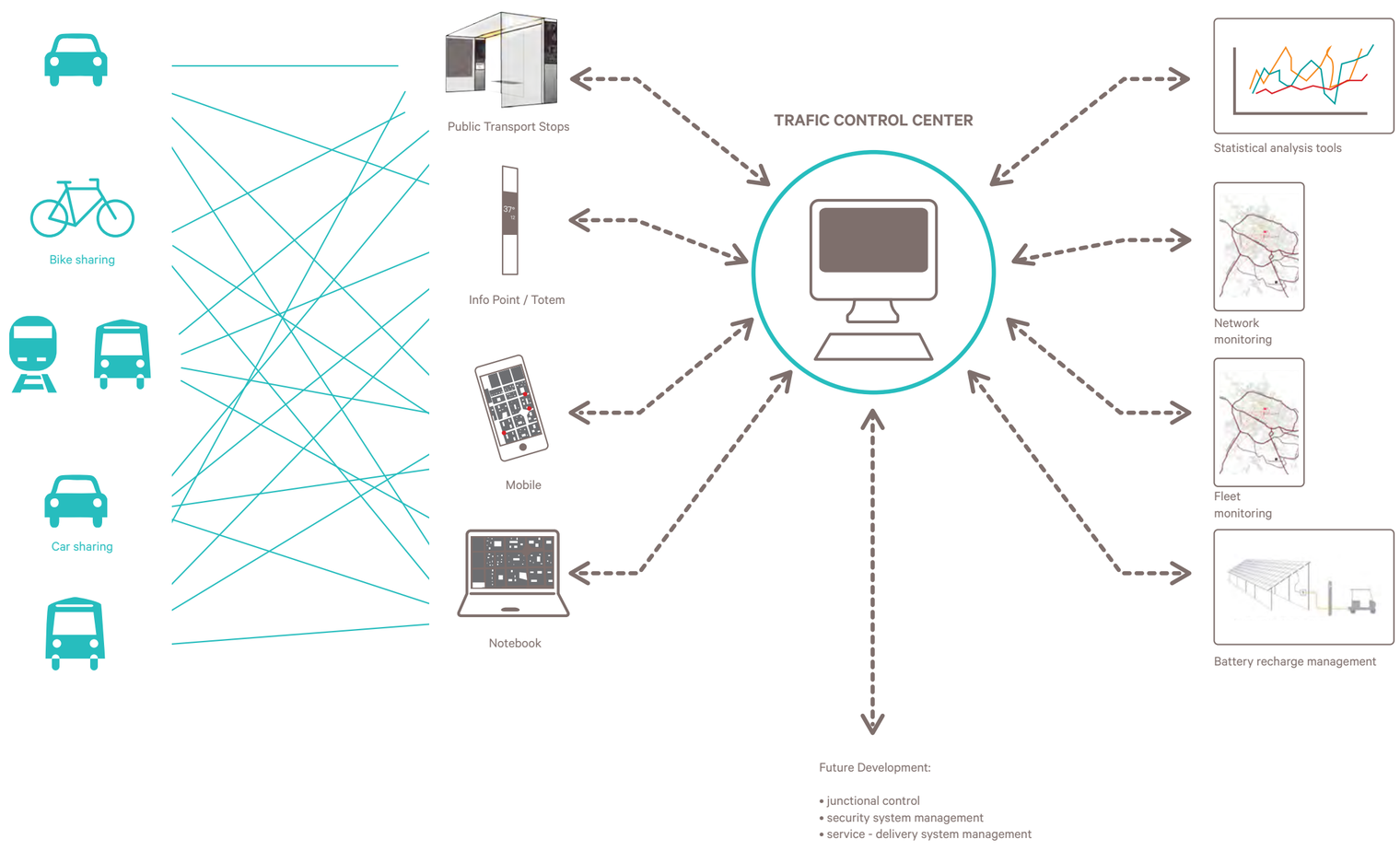
The CCD digital mobility plattform



17.7.2. CCD digital public transport management system

The digital technology associated with the use of new forms of transportation (MOD or car sharing) within a complex public transportation system, provides a variety of new tools to the user and inevitably changes the “vocabulary” of the urban travel.

The daily journey changes shape and diversify itself. It begins with the search for the information needed to travel: the platform can suggest the most suitable route to reach point B from point A, or may simply provide information on schedules and stops of a particular line of public transport sought by the user.
The user can then choose the route and possibly reserve it or pay in advance and/or load it on his card (or make sure it is a path covered by his previous subscription).
At that point the user can make the trip, checking the connections and combining different kind of transport. To combine different kind of transport could mean to cover bigger distances by BRT and to finish the journey by a bike-sharing bicycle for the last few blocks.

Similarly, the provider will benefit from the user’s journey, learning from his preferences in order to improve the service management.

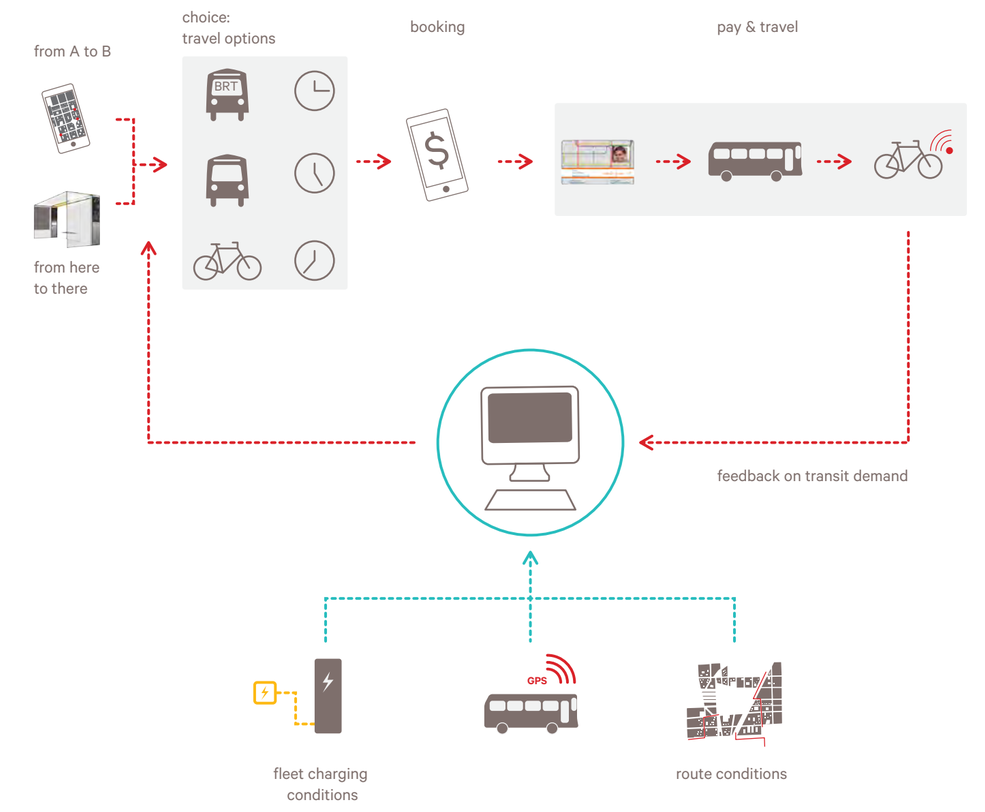
Providing the fleet with an on-board GPS system will be an essential part of the plan and will bring benefits to both the user and the provider, who will always be aware of the general state of the system (position, times and state of charge of electric vehicles). Dually, the drivers will also have access to the whole set of digital data (breakdowns, road blocks and rerouting) through the in-vehicle terminal.

In order to further improve the user interface, another proposal is to to use the BRT stations as real time information centres for the entire public transport network: not only BRT stations, but smart terminals for the network and the master plan, allowing the users to directly consult the interactive panels and in the very same moment have the whole CCD mobility offer in their hands.

The digital technology associated with the use of new forms of transportation provides a variety of new tools to the user and inevitably changes the “vocabulary” of the urban travel.

The Macrobus smart termnal

A smart trip experience in the CCD

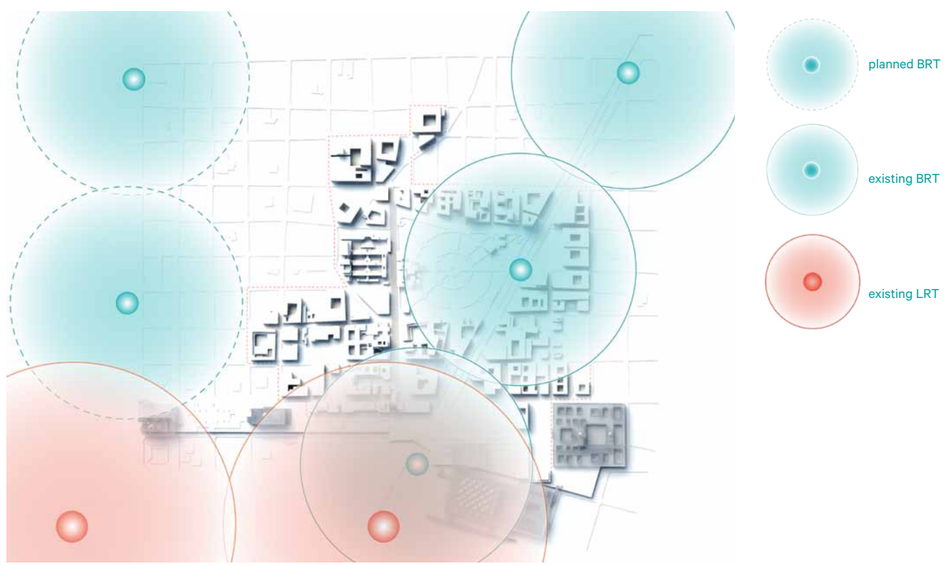


17.7.3. The CCD and the public transport

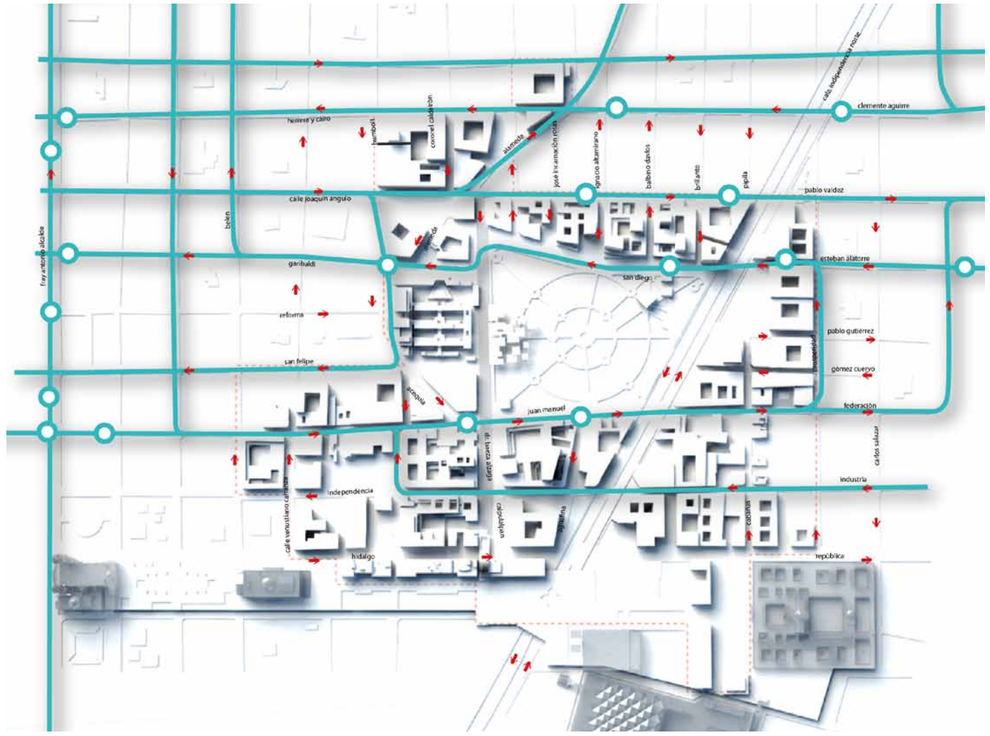
Thanks to the extended coverage of the primary transport stops, the main accessibility channels between the CCD and the rest of the city are undoubtedly characterized by a great potential. The possibility of including these systems - the Macrobus and the Tren Ligero - within the master plan digital management system will produce immediate benefits for the users. The retrieval of real-time data from the introduction, planned by SITEUR starting from 2013, of GPS-based VAL systems on the Macrobus fleet, will allow to update the users on the fleet location and waiting times, therefore optimizing the boarding activity and reducing the time of the trip. The diffusion of these information through the public smart terminals or on the different smart devices will also improve the exchange between different systems, enhancing the overall efficiency. Moreover, as described, the digital management system will provide the customer with booking and ticketing options, as well as with pre-selected and optimized multi-modal travel options. From the provider's standpoint, the operational data sharing will help retrieving statistics and demand information so to optimize the service (fleet, route, stops), it will make also possible to monitor the fleet's conditions and improve the maintenance.
With regards to the local transport, it has already been mentioned how the presence of different private providers has defined the bus routes and stops more in relation to the lows of the market, that to the definition of the most effective transport solution. In these pages, is presented a possible modification tot he local bus routes for the CCD area, as tested and optimized with the CCD micro-simuation model. The main change refers to the shift of the routes passing along San Diego street, on parallel and less congested - when referring to the final phase scenario - streets. In particular, those lines coming along Esteban Alatorre will divert to the north when still on the east side of the Calzada Independencia, and then rejoin the westbound axis on Herrera y Cairo. With regards to the bus stops, the map describing the existing conditions only shows the official stops. Nevertheless, as discussed in paragraph 5, the sensitive test on the removal of a certain amount of bus stops (in particular the unofficial ones, which currently are much more diffuse than the official ones), doesn't affect significantly the traffic indicators. This considered, the map showing the proposal for the local transport rerouting also includes the re-definition of the bus stops, based on the distance and the different operating lines. It should be noticed that the shifting of the bus rout and corresponding stops from San Diego to other roads further north, doesn't significantly affect the master plan coverage and accessibility, given the buffers' size and the scale of the CCD area. With regards tot he digital management system, even if the current providers' situation is rather complex, the potential inclusion of the local bus lines in the multi-modal mobility frame will constitute a major improvement in the overall system's efficiency. As a consequence of introducing GPS location systems on the fleet, the buses could be part of the multi-modal transit offer, undergoing the optimization process along with the rest of the travel modes.

Including the primary and local public transport systems in the master plan digital management system will produce immediate benefits for both the users and the provider, thanks to the retrieval and sharing of real-time data.

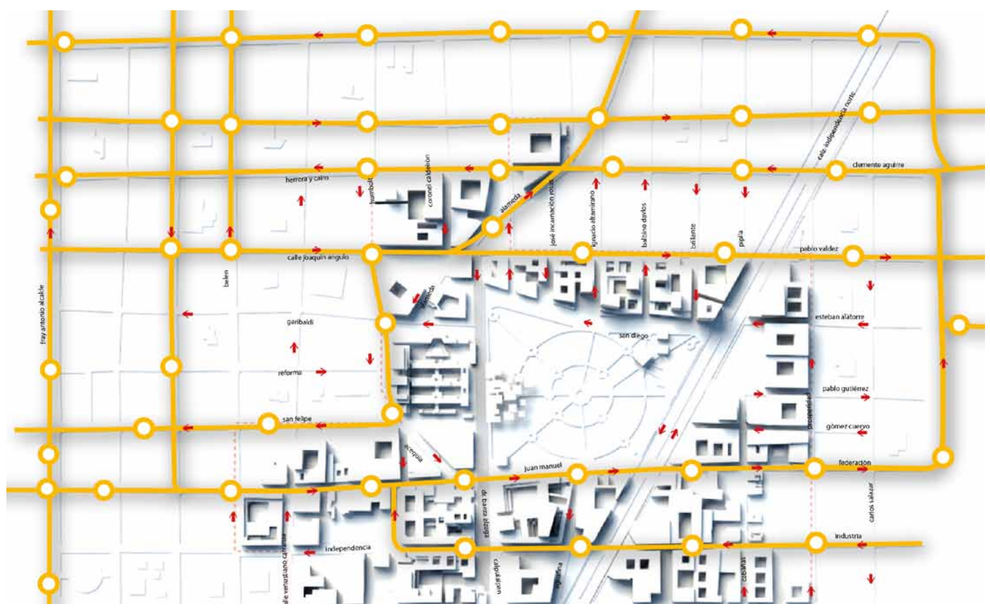
A smart trip experience in the CCD



existing local bus routes



proposed local bus routes



17.7.4.
Pilot programs: the CCD MOD system

As discussed for the re-linking of the CCD MoD system to the DUIS scale and existing *Bikla* system, providing this type of on-demand solution will enhance the flexibility of the mobility master plan frame, giving the users an efficient support to personalize the trip option. This initiative will therefore complete the picture of a competitive multimodal transport system, further sustaining the usage of the public transport network. The presence of a structured digital platform plays a fundamental role in the successful implementation of such program, maximizing the user accessibility and system's efficiency at once. Availability check and booking operations will be managed on-line. On the provider's side, the management system will help fleet's maintenance, vehicles' redistribution and system optimization through data collection. The CCD MoD system is though for every kind of user and can be exploited for any internal or short range movement, dropping the need for taking the car to perform short trips. It will also play a role in the commuting, in order to cope with the so called "last mile problem".

The station hierarchy for MoD systems counts primary, secondary and local stations.

Primary stations, positioned at major origin and destination points, host a considerable number of vehicles. They are large, permanent mobility interchange points that can incorporate retail and service facilities.

Secondary stations can be combined with existing service points. They are characterized by lighter structures compared to major stations.

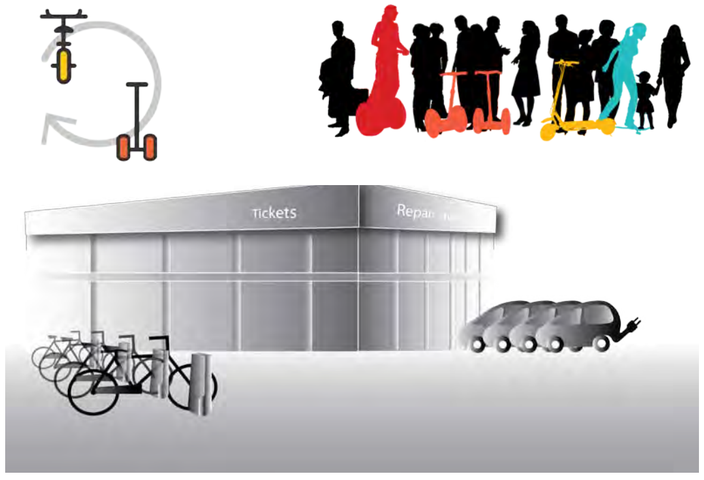
Local stations are very light if not temporary structures and they host fewer vehicles. They compose a fine-grained network.

CCD MOD's vehicles will range from normal bikes to high tech and innovative ones, in the frame of supporting the development of prototypes and new solutions. These can also require to provide power supply for the vehicles and not only for the station's interface totem, which necessities can generally be fulfilled by small solar panels.

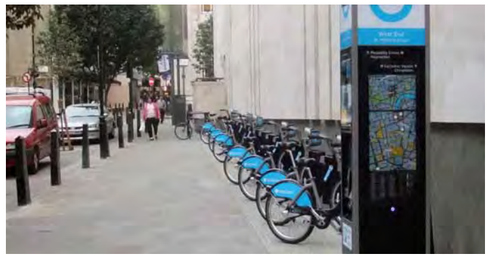
The option of including segweys-type vehicles is part of the overall vision that strongly focuses on the pedestrian environment. The possibility of shifting towards devices specifically thought for pedestrian environments will further enhance the master plan livability and comfort. These vehicles can be, especially in a very first testing phase, a small share of the vehicles available at the primary and secondary stations, in the range of maximum a fourth of the available vehicles at primary and secondary stations.

The CCD MoD system is though for every kind of user and can be exploited for any internal or short range movement, giving the CCD people an efficient support to personalize the trip option.

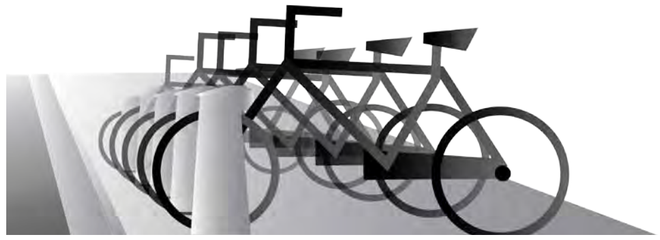
primary MoD station



secondary MoD station



local MoD station



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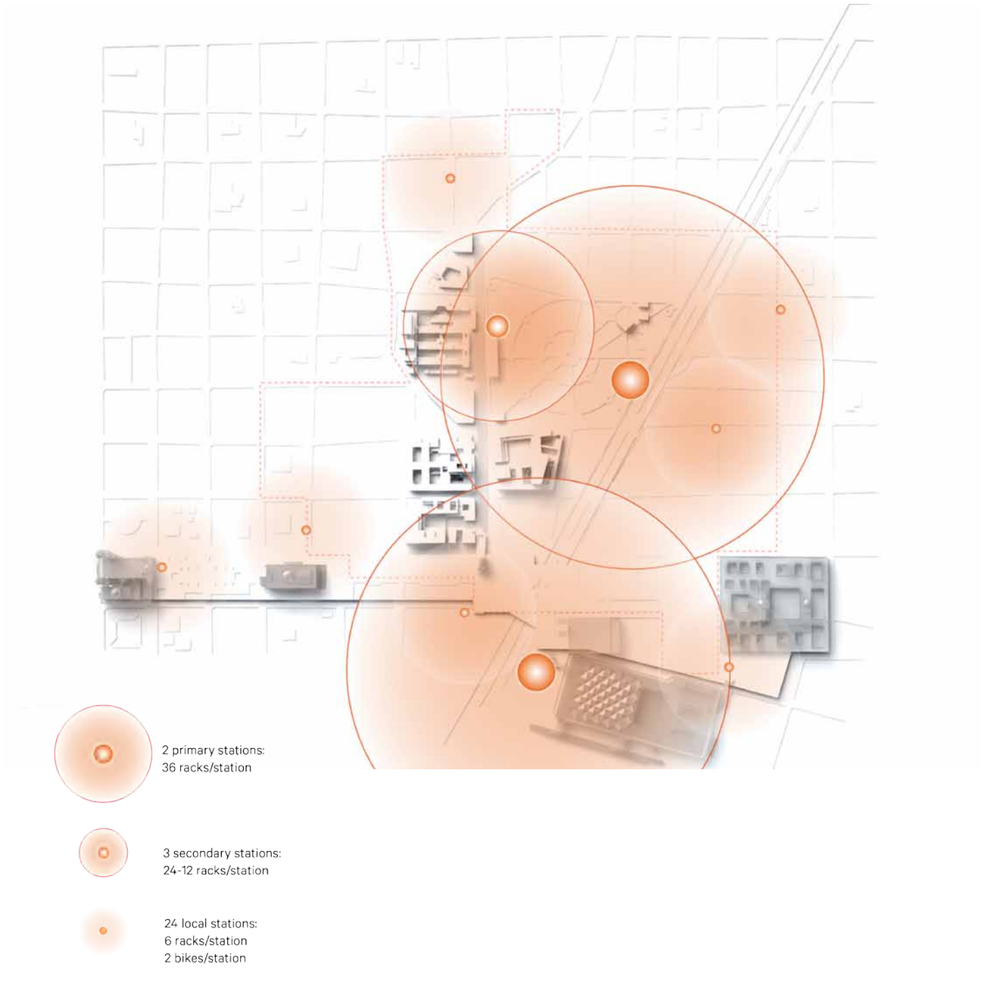
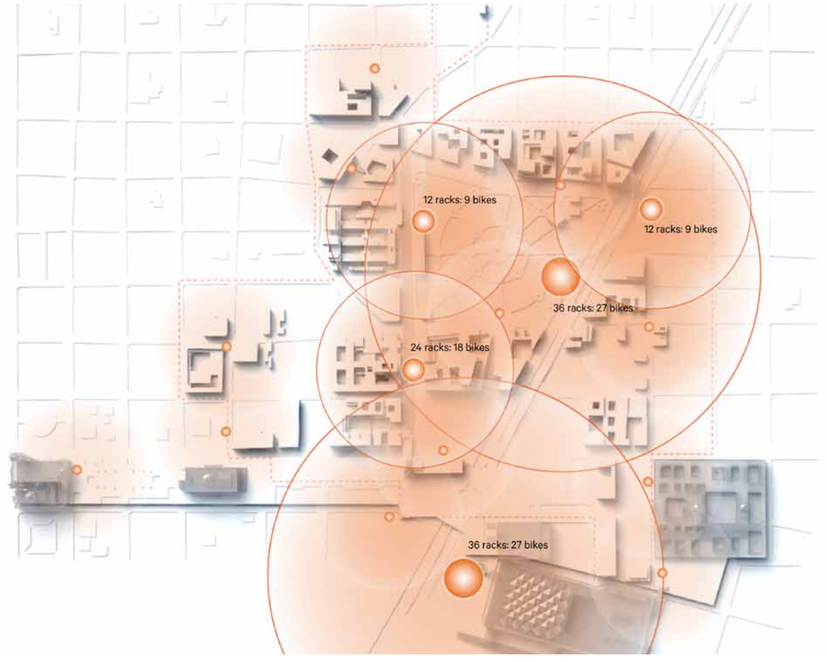
In these pages, the distribution of the CCD MoD primary, secondary and local stops as proposed in relation to the master plan land use phasing. Primary stops, generally located in proximity of main generators, such as the Macrobus stops and the main master plan parking facility, will host 36 racks and 27 bicycles. The secondary stops will be smaller, hosting and average of 12 racks and 9 vehicles, and will mostly serve other master plan's points of attraction, such as the Ingenium Campus or the M4. Following the development in the next two phases, a series of local stations will be introduced in order to obtain a fine grained system and always guarantee the required coverage. Nevertheless, the local racks will not follow a strict coverage principle but a general fine grained distribution trying to achieve the best on-demand service. These racks will be formed by 6 spaces hosting no more than 2 or 3 vehicles per station. Moreover, as a general rule it has to be noticed that one of the main plus of the mod systems is the flexibility of their implementation - mostly thanks to the easy installation of local stations - and this is actually one of the aspects at the base of the mod system's sizing, which is generally an incremental process that follows-up the master plan development and real demand.

The maps show the distribution of the CCD MoD primary, secondary and local stops as proposed in relation to the master plan land use phasing

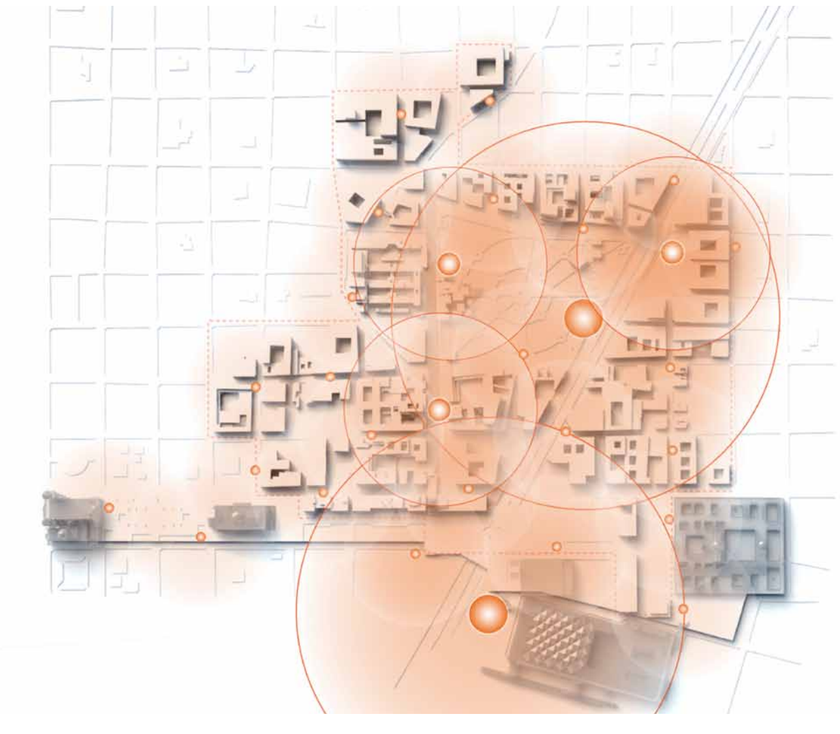
parking levels required in ph.1



ph. 2 CCD MoD stations



ph. 3 CCD MoD stations



17.7.5.
Pilot programs: the CCD car-sharing

The proposal of developing a dedicated car-sharing program for the CCD links back to the goal of minimizing the necessity of using or even owning a private car for those living and working on the CCD. Relying on an efficient and multimodal transport system when referring to the systematic trips, it must be considered the necessity of providing the undeniable flexibility of a private vehicle when needed. The proposed solution will fill the gap in all those situations such as the necessity of going to a meeting or going shopping somewhere where public transport is not a convenient option. Providing a series of EVs on-site, that can be rented as part of the overall CCD mobility system, will satisfy these necessities even if in the initial start-up phase the cars have to be returned tot he very same parking spot or in any case somewhere within the CCD. This is due to the need of creating a network of recharging points that supports the system, which is part of the CCD pilot programs, This request can of course hardly be extended to the rest of the city from day one, but the CCD car sharing can definitely turn into a different management approach the moment that the required infrastructure will support it around town. .The envisioned final scenario will be aligned with some of the most advanced cases, such as the Car2Go system, that offers world wide urban based car-sharing systems, where one can pick up the car and park it in a totally different pace when dropping it. The CCD pilot program will include high tech and all electric vehicles in order to stay aligned with the declared project's sustainable and cutting edge vocation.

The proposal of developing a dedicated car-sharing program for the CCD links back to the goal of minimizing the necessity of using or even owning a private car for those living and working on the CCD

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Lorem ipsum

CCD car-sharing spots

Ph 1

Ph 2

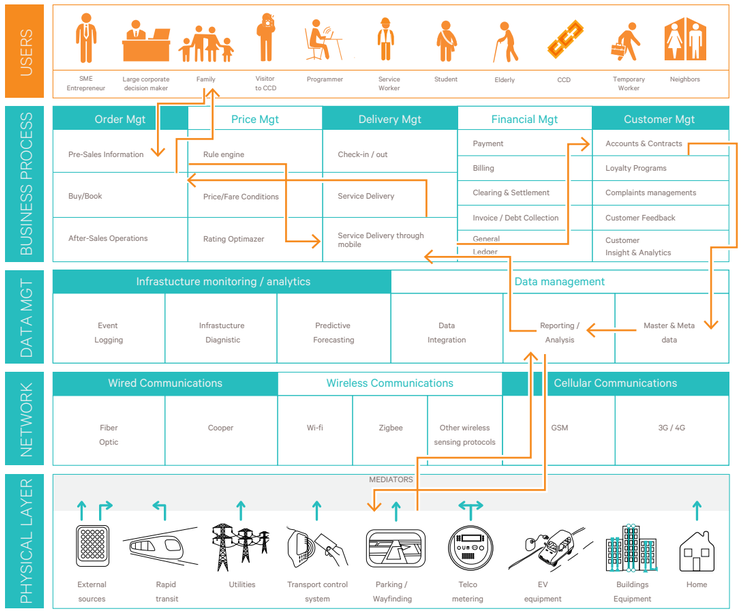
Ph 3

stations in existing structures

local stations

17.7.6.
Digital mobility system: an overview

Smart parking road-map



Fernando – a worker and resident of the CCD is now able to pre book his favorite parking space close to his office in the morning

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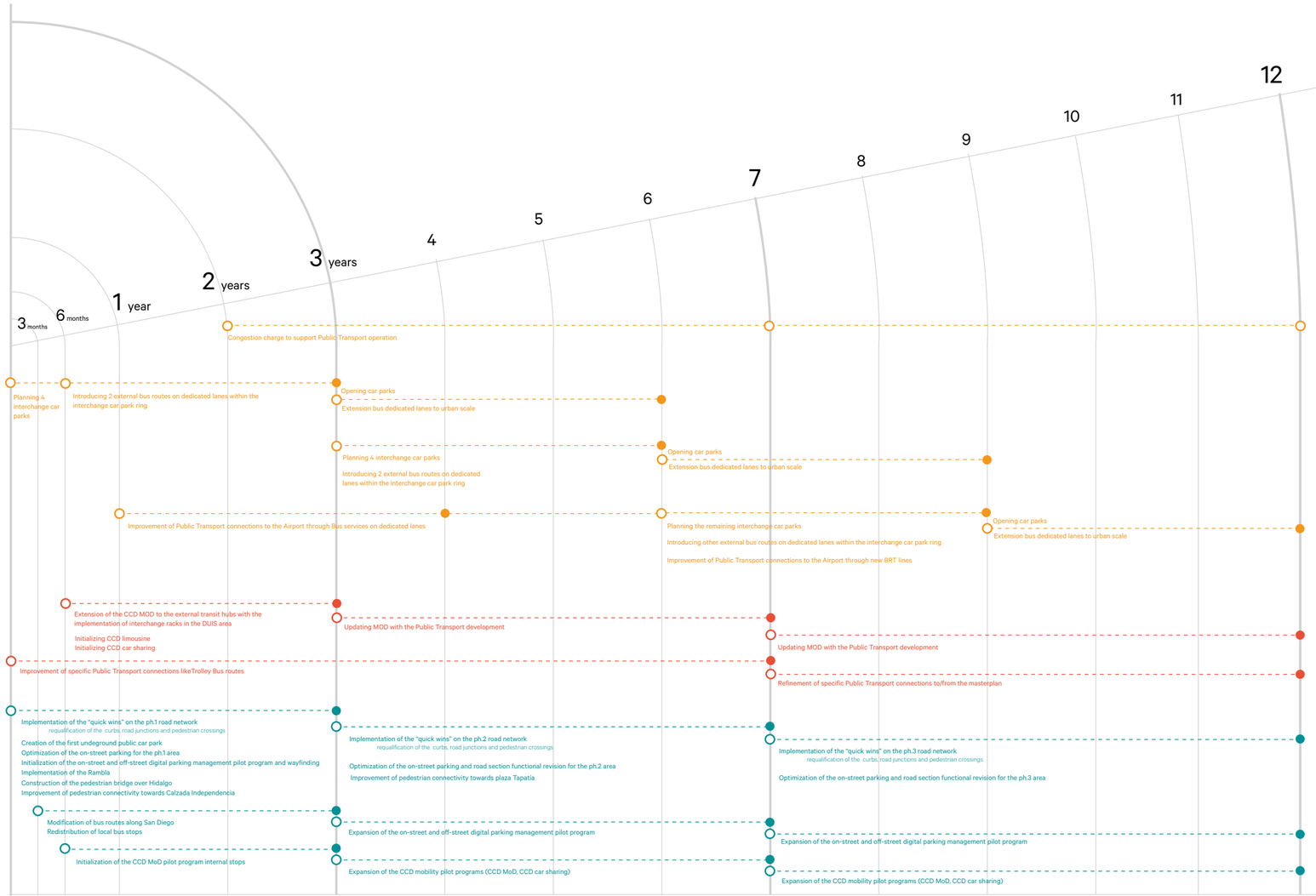
17.8. Roadmap

17.8.1. Mobility roadmap

The mobility plan for the Ciudad Creativa Digital will be the outcome of a series of actions that will involve and link together different scales of intervention for the duration of the masterplan development timeframe. As already highlighted, the importance of considering the initiatives at the wider scale is of fundamental importance for a successful development of the master plan mobility project. Hence the different steps clearly defined in the roadmap as if they were actually completely integrated in the CCD operational diagram. The incremental introduction of dedicated bus lanes for the city local public transport, and the way these interventions will be supported and coordinated with other broader strategies such as the creation of an interchange car park ring or the introduction of a road pricing strategy, are bundled to the necessary improvement of the accessibility to the city centre and to the CCD itself. Another set of actions included in the roadmap is, on the other side, strictly related to the local scale, that is the CCD architectural master paln and its phases.Some of the most immediate and effective interventions that are planned for the very firat phases and that will improve the overall quality of the master paln road network are tied tot he progress of the master plan construction as well as to the lay-down of the utilities. In particular the implementation of those "quick wins" that refers to the upgrade of the road junctions and sections through the renewal of the road network is here pahsed-out with the implicit necessity of a further coordination with the overall master paln development.

The phasing of the mobility plan coordinates all the actions at different scales, from urban to local, as an implicit consequence of the strict relation between the cityscale mobility and the successful integration of the CCD in the overall context.

Mobility roadmap at the city, DUIS and CCD scale until the completion of phase 3 in year 2024



18

Urban Infrastructure: **Telecoms**

Urban Infrastructure

Executive Summary

The various elements of urban infrastructure and utilities for CCD are described in the following chapters. These are: telecoms, power and electricity, water and waste water management and resource and waste management. Following the DUIS requirements and aspirational targets to meet across these various elements, CCD has decided to implement higher standards throughout the project. These proposals will be rolled out across the 3 phases of development. The main objectives of the urban infrastructure in CCD are:

- To develop the network and urban infrastructure components of an urban operating system with a particular focus on infrastructure required to support a multi-sensored and actuated environment.
- To review and coordinate the future needs on energy supply from the grid with the understanding on the "shift" to renewables within CCD and the reduction on energy consumption from the initial phase.
- Ensure that the existing water supply network has the capacity to accommodate future demand and provide an outline of the dual waste water discharge networks to ensure a fully on site recycling system;

During phase 1, the urban infrastructure at CCD will include the incorporation of the design guidelines for all new buildings in terms of telecoms connectivity to the smart grid system, new water management mechanisms and on site recycling areas for solid waste. The various ICT and network requirements for the specific digital industry should be procured aiming for CCD to have both, ownership of the infrastructure and the services provided.

During phase 2, once achieved a critical mass of new development, CCD and the city of Guadalajara should start the upgrading systems on storm water main routes to integrate the proposed on site water retention systems in the park to this network. Also, by this phase, the power and electricity lines should be buried and the proposed street lighting should be rolled out through the main streets of CCD.

In phase 3, with the completion of all the developable area and with the construction of the majority of the residential components, the on-site solid waste strategy should be upgraded with the proposed alternatives of underground collection systems. As the infrastructure would run beneath secondary streets, it is envisaged that all the utilities

The telecoms infrastructure at CCD is fundamental for both, the branding of the project and the efficient physical support for the various digital services on offer. There are 3 main components for the site wide telecoms infrastructure: telecoms ducts and fiber network, wireless LAN mesh network infrastructure and cellular network infrastructure. The latter two should aim to be in place from phase 1 of the project while the former should be rolled out –or upgraded in phases.

In terms of power and electricity, we focused on street lighting as this is a major issue in the area in terms of security and image. For power provision, If CCD aspiration is to become an exemplar project for the digital industries, the topic of power generation is fundamental.

In terms of water managment (water & wastewater) The aspiration, targets and opportunities described, focus primarily on the implementation of Phase 1. With positive momentum from the work on Phase 0, some considerations for potential options for additional treatment and flood mitigation have been provided Phases 2 & 3. Between these various elements water demand for CCD will be reduced by 40% from a Business as Usual case and 60% of the water demand for phase 1 would be from onsite recycle system.

As a landmark project with international exposure, CCD needs to ensure a successful model of waste management collection on site, to provide a clean, efficient and digital based service to the community.
In addition to the above, CCD needs to follow on what are the best practices worldwide on waste collection systems and management and adopt the principle of "waste as a resource" and potential generator of income. Our approach and aspirations sets are of high standard. The preliminary strategies described here, aim to place CCD ahead of this curve of knowledge and expertise to position the project at the forefront of waste management.
The alternatives outlined here will make CCD comply not only with the DUIS requirements on site waste segregation and collection but will allow CCD to stop emitting over 170 tons of C02 from waste diverting from landfill and over 110 tons of C02 from potential biogas used to generate electricity. The proposed systems to optimize waste collection on site are intended to operate at two different levels. At a building level, the proposal tries to reduce the space requirements for waste collection. At a district scale the systems proposed will reduce substantially the traffic from waste collection, noise and air pollution.
As CCD will not generate enough waste to provide a cost effective on site treatment plan, the proposal also seeks further consideration to showcase alternatives on CCD becoming a "test-filed" for organic anaerobic station for two municipal markets located in close proximity. Further studies are required to prove the feasibility on implementing these technologies.

PHASE 3

1. Green roofs on 35% of roof surface area for new buildings
2. On site organic waste container biodigestor
3. Parque Morelos water retention pond system at eastern edge
4. Fibre backbone for telecoms full site
5. Intelligent street lighting on key corridors
6. proposed upgrade of buried power lines for phase 2 and 3 including reflexion centres and substations

3

PHASE 2

1. Intelligent street lighting on park
2. CCD Infobox, store of apps from users and exchange on info for other apps
3. Green roofs on 35% of roof surface area for new buildings
4. Complete wireless network for phase 3
5. Iproposed upgrade of buried power lines for phase 2 and 3 including reflexion centres and substations

2

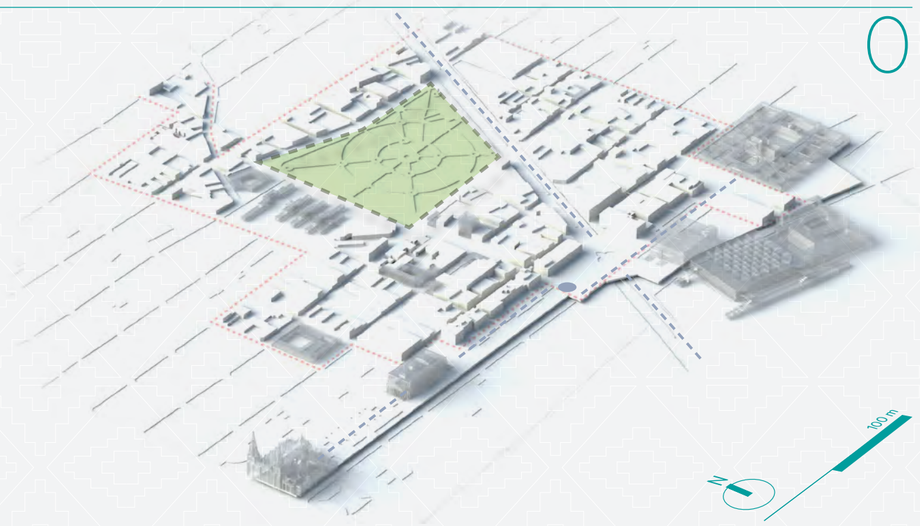
PHASE 1

1. Parque Morelos water retention pond system at northern edge
2. On site waste recycling point and collection centre
3. new storm water network to the park along the ramblas
4. proposed upgrade of buried power lines for phase 1
5. Wireless network
6. Green roofs on 35% of roof surface area for new buildings
7. Wireless network in place for Parque Morelos, Ramblas, Digital Art
8. Fibre backbone for telecoms phase 1

1

PHASE 0

0



18.1.

Site Conditions and DUIS Requirements

SITE CONDITIONS

The existing telecoms network within the CCD proejct area seems to be the mexican standard for land lines across the city. At present Arup is working with the client to understand the full extend of the network and the location of the telcos exchange points. Around Plaza tapatia, recently has been installed a wireless network anchored around 11 points with a 2GB download average speed .

DUIS REQUIREMENTS

There are a number of Information and Communications Technology (ICT) related requirements and proposals that DUIS certified building developments should consider. These can be categorised as follows:

1 Public telecoms network requirements
- Fibre optic backbone with a capacity of at least 10Gbps
- Network to cover entire DUIS polygon
- A certain level of resiliency required

2 Public space information service requirements
- Expansion of existing e-government platform – available via web, mobile apps and digital kiosks
- Public transport services – real time statistics on positions and estimated arrival times
- Publishing of urban information via city displays
- Free fixed-line internet access at libraries, educational, cultural, health and public administration institutes – 50Mbps down, 10Mbps up
- Public wi-fi in line with other world cities. Free GDL - currently free WiFi of 2Mbps speed available at certain zones in the city

3 Residential housing requirements
- Internet access capabilities of at least 50 Mbps download and 10 Mbps upload
- Improved interaction between residents and city services – public informational and e-government services
- Digital systems that enable households to efficiently utilize energy resources

4 Urban maintenance services
- Intelligent traffic light system – real-time routing of traffic
- Water monitoring – water flow and leakage detection
- Irrigation – efficient irrigation by implementing moisture sensors
- Waste management – efficient collection of waste by remote sensing of real-time container capacity
- Intelligent LED lighting – solar powered, emitted light controlled by ambient light
- Efficient use of electricity – all systems should save energy when not in use

5 Public safety services
- CCTV – identify number-plates, faces, suspicious behaviour
- Emergency system – bus stop panic button, also linked to mobile app, to summon emergency services
- Intelligent urban security system – real-time location of emergency response units to efficiently route to an emergency situation

6 Digital hub requirements
- Systems to detect earthquakes and flooding and automatically correspond with emergency services
- Systems that support energy efficient public realm lighting

> "There are a number of Information and Communications Technology (ICT) related requirements and proposals that DUIS certified building developments should consider."

DUIS ITC REQUIREMENTS BENCHMARKING

The DUIS requirements for residential and public area internet access speeds are on a par with other developed cities around the world, as can be seen from the benchmarking tables shown here.

RESIDENTIAL UPLOAD SPEEDS

Rank	City	Speed (Mbps)	Rank	City	Speed
1	Vilnius, Lithuania	36.63	21	Singapore	17.38
2	Central District, Hong Kong	30.51	Outside top 30	Lisbon, Portugal	4.65
3	Seoul, Korea	30.34	Outside top 30	Stockholm, Sweden	9.26
4	Kaunas, Lithuania	23.68	Outside top 30	Amsterdam, Netherlands (Dutch average)	8.48

Rank	Country	Speed (Mbps)	Rank	Country	Speed
1	Hong Kong	28.90	6	Romania	15.72
2	South Korea	28.65	7	Bulgaria	13.75
3	Lithuania	27.72	8	Russia	13.55
4	Latvia	18.73	9	Moldova	12.93
5	Singapore	17.39	10	Japan	12.75

RESIDENTIAL DOWNLOAD SPEEDS

Rank	City	Speed (Mbps)	Rank	City	Speed
1	Central District, Hong Kong	44.43	9	Singapore	30.81
2	Vilnius, Lithuania	40.62	13	Lisbon, Portugal	27.47
3	Taipei, Taiwan	38.23	16	Stockholm, Sweden	27.01
4	Seoul, Korea	35.40	24	Amsterdam, Netherlands	25.73

	Country	Q1 '12 Avg. Mbps
–	Global	2.6
1	South Korea	15.7
2	Japan	10.9
3	Hong Kong	9.3
4	Netherlands	8.8
5	Latvia	8.8
6	Switzerland	8.1
7	Ireland	7.3
8	Czech Republic	7.1
9	Belgium	7.1
10	Finland	6.9

18.2.

Constraints & Opportunities

CONSTRAINTS

At present the telecoms infrastructure in downtown Guadalajara provides a good base for high speed internet access and wireless network. However, due to the nature of the CCD project and the industry sector that would be located here, there will be the need to revise key aspects of the existing infrastructure, capacity to grow and network ownership to ensure a good telecoms platform and infrastructure is in place. These are:

- Current telecoms legal framework in Mexico.

The telecoms regulatory framework in Mexico may constrain the development of existing and new telecoms networks. Licensing requirements need to be carefully analysed in order to understand the opportunities further. Detailed discussions will be required with the regulator and telecoms companies in order to fully understand the possibilities.

- Current physical duct and fibre network.

Any proposed duct and fibre network will need to be integrated into the existing telecoms duct and fibre infrastructure. The physical capacity of the existing telecoms duct network is unknown at this time and might prevent the addition of further fibre to extend the network to the CCD.

- Capacity of exchanges for international connectivity.

The type of industry expected to be attracted to the CCD will require high bandwidth international connectivity. The capacity of the existing international exchange might prove a constraint on providing the required connectivity levels.

- Backbone capacity at the city level.

The capacity of the existing city fibre backbone may not be great enough to handle the additional bandwidth requirements involved in connecting up the CCD polygon.

OPPORTUNITIES

CCD will need to consider providing greater fibre backbone capacity than 10 Gbps, depending on anticipated usage of the network. Extra physical duct capacity should certainly be provided in order to allow the flexibility of adding fibre to increase capacity at a later date.

Infrastructure	DUIS requirement	Compared to benchmark
Libraries, educational, cultural, health and public administration institutes	Free fixed -line internet access - 50Mbps down, 10Mbps up	Favourable comparison with global city speeds
Wi -fi in public spaces	Public wi -fi in line with other world cities. Free GDL - currently free WiFi of 2Mbps speed available at certain zones in the city	2Mbps public wi -fi speed is comparable to other developed cities. Having complete coverage across the CCD would compare favourably to other city centres where coverage is more sporadically provided
Residential property	Internet access capabilities of at least 50 Mbps download and 10 Mbps upload	Favourable comparison with global city speeds
Commercial property	No DUIS requirement identified	Other creative clusters and businesses aiming for speeds of 1Gbps +
Fibre backbone	10 Gbps	Depending on services running over this backbone, 10 Gbps may be inadequate. CCD will need to provide physical duct capacity for adding more fibre as required

18.3.

Existing Physical Infrastructure

EXISTING TELECOMS FIBRE NETWORK

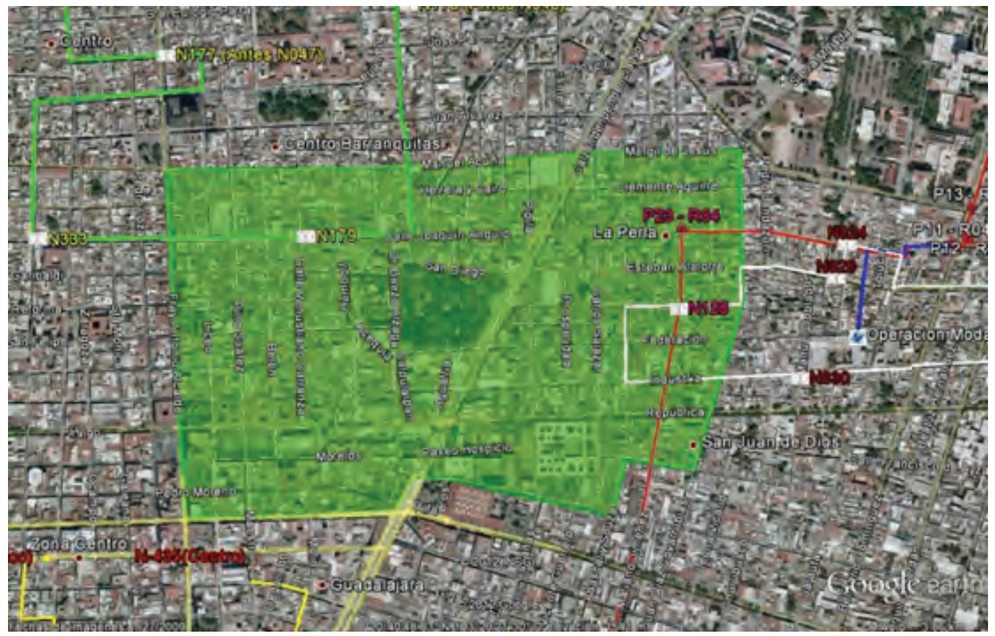
The image on the left outlines the existing telecoms fibre infrastructure, and node distribution points, relating to the CCD polygon, whilst the image below shows the telecoms exchanges nearest to the CCD polygon.

The fibre network for the CCD would be required to build on and integrate with the existing fibre network, in a phased approach

ASSUMPTIONS

- The nodes shown would be the breakout distribution points for connecting into the existing fibre network
- Build on existing network and connect to nearest existing nodes
- Connect into two separate nodes (with the assumption that these are connected to separate exchanges (hubs) for resiliency
- The existing duct network has enough capacity to pull in new fibre as required

Existing telecoms exchange, source: Ayuntamiento de Guadalajara



Existing telecoms fibre network, source: Ayuntamiento de Guadalajara

18.4.

Proposed Physical Infrastructure

SITE WIDE INFRASTRUCTURE

The main objectives in developing site wide digital infrastructure are to provide:

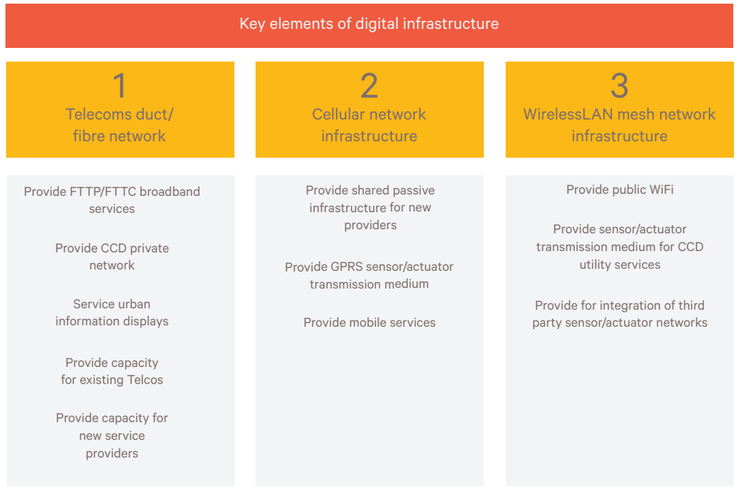
- A network for CCD to provide municipality and utility services such as smart street lighting, security services and smart metering
- A network to support the integration of urban informatics and information feedback to residents
- A scalable and flexible technology architecture that allows multiple third party service providers to integrate their own infrastructure and services as required in the future
- ITC infrastructure suitable for meeting and exceeding DUIS requirements and proposals
- An infrastructure that meets commercial business communications requirements

There are three key elements of digital infrastructure:

1. Fibre network
2. Cellular network
3. Wireless LANmesh network

These infrastructure elements provide the underlying communications network for enabling the multi sensored and actuated environment that is envisaged for the CCD area.

Key elements of the digital infrastructure



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TELECOMS DUCT INFRASTRUCTURE FOR PHASE 1

A comprehensive duct infrastructure under existing roads will be required to support not only the CCD fibre network but also:

- Fibre infrastructure for Telecoms providers
- Capacity for energy and utilities companies to provide services
- Potential capacity for an automated waste collection system

The duct network should be capable of being developed in a phased manner, according to the CCD development phases.
CCD could consider using shared utility services corridors similar to the 22@ project in Barcelona.

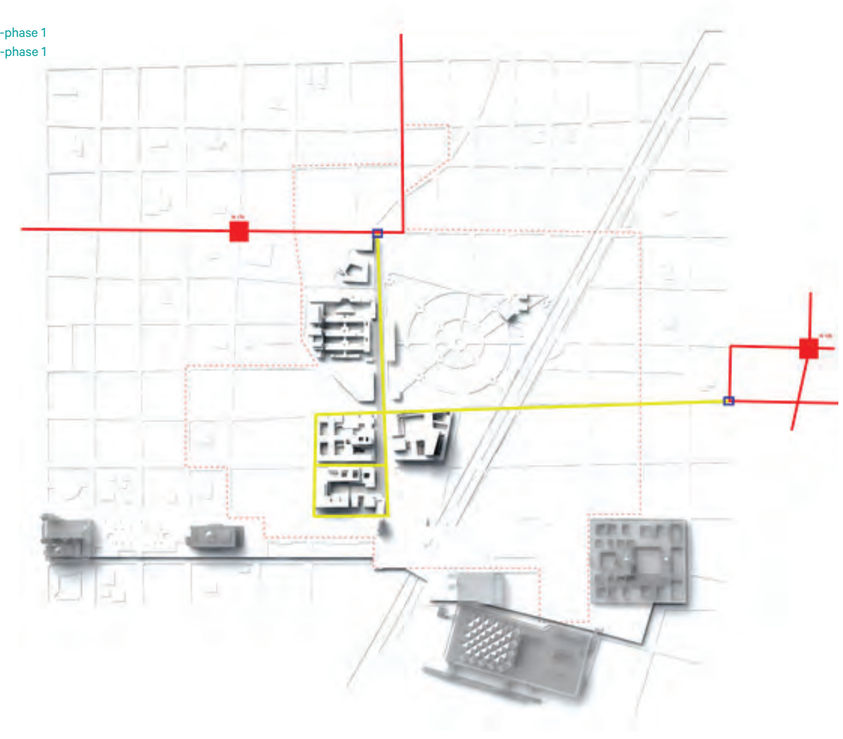
Key Considerations:

- Two incoming routes into the CCD area from separate Telecoms exchanges provide for diversity and initial resilience
- Resilience at a building scale can be provided at different levels according to requirements. Could have two physically separate ducts coming into the building or different fibre cores in the same duct
- As a general principle to guide capacity requirements:
- Main roads should have a minimum of 8 No. 110mm ducts
- Secondary roads should have a minimum of 4 No. 110mm ducts

Chambers should be added to the duct network:

- At street intersections to support easy future duct integration
- At key building locations to support Fibre to the Premise (FTTP)
- At locations where connectivity with urban informatics is required

Legend:
Indicative 8 duct network-phase 1
Indicative 4 duct network-phase 1



TELECOMS DUCT INFRASTRUCTURE FOR PHASE 2

Telecoms duct network key considerations:

- Two incoming routes into the CCD area from separate Telecoms exchanges provide for diversity and initial resilience. Further resilience could be provided by separate duct networks on each side of the street;
- Resilience at a building scale can be provided at different levels according to requirements. Could have two physically separate ducts coming into the building or different fibre cores in the same duct.

As a general principle to guide capacity requirements:

- Main roads should have a minimum of 8 No. 110mm ducts
- Secondary roads should have a minimum of 4 No. 110mm ducts

Chambers should be added to the duct network:

- At street intersections to support easy future duct integration
- At key building locations to support Fibre to the Premise (FTTP)
- At locations where connectivity with urban informatics is required

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TELECOMS DUCT INFRASTRUCTURE FOR PHASE 3

The required extensivity of the telecoms duct network will depend on numerous factors:

- The CCD vision for Fibre To The Premise (FTTP). Which properties in the CCD area will required FTTP? Will Fibre To The Cabinet (FTTC) suffice in some circumstances?
- The location and number of building telecoms entry points for the different development plots

Key Assumptions:

This presentation has assumed that a fully comprehensive duct network will be required in order to provide FTTP services to the majority of CCD buildings, however further detailed analysis and design would be required in order to value engineer the duct network once requirements have been more clearly defined.

TELECOMS DUCT INFRASTRUCTURE - POTENTIAL MODELS

Careful thought needs to be given to planning the telecoms duct network in order to ensure it is fit for purpose and scalable for all future requirements.
As a general rule, 60-80% of the cost of laying a fibre network is associated with digging the duct infrastructure. It therefore makes commercial sense to explore ways of reducing or sharing the cost associated with putting the duct network in, or of recouping some of these costs at a later stage.

Reduce costs upfront:

- Sharing the costs with multiple Telcos and cable TV operators who will want to extend their existing network to provide services to CCD
- Sharing the cost of new duct networks with energy and utilities companies and having shared utility ducts
- Using the existing infrastructure that utilities companies have in place – for example, fibre networks can be deployed aerially, in gas pipes, water pipes and sewer pipes

Partially recoup costs later:

- CCD may want to own the entire duct infrastructure from the outset and then recoup costs by renting the infrastructure to Telcos, cable TV operators and energy and utilities companies

Future proof duct network:

- 22@ Barcelona provides an example of infrastructure development that will allow for future proofing of capacity requirements. A network of under-road service galleries enables a host of utility services - energy, telecommunications, district heating and cooling, pneumatic waste collection and electricity systems. These service networks can be maintained and improved without the need for costly street excavations and provide capacity for future services.

WIRELESS LAN INFRASTRUCTURE

Putting in place a wireless LAN infrastructure that provides wi-fi coverage for the whole of the CCD area is beneficial in the following ways.

This infrastructure can be used to enhance the digital lifestyle of those in the CCD through the provision of internet services through public wi-fi throughout the area Separate virtual LANs could be set up on this wireless infrastructure to provide a medium for the CCD to integrate its utility sensor and actuator networks – i.e.

Wireless LAN infrastructure would consist of a series of wireless access points mounted on street furniture such as street lights across the CCD.

Several of these access points would be required to be connected into the underlying fibre network in order to provide the required connectivity.

Extending the coverage of such a wireless network is relatively simple since additional access points can be added to existing street furniture without the need for extending the underlying fibre network.

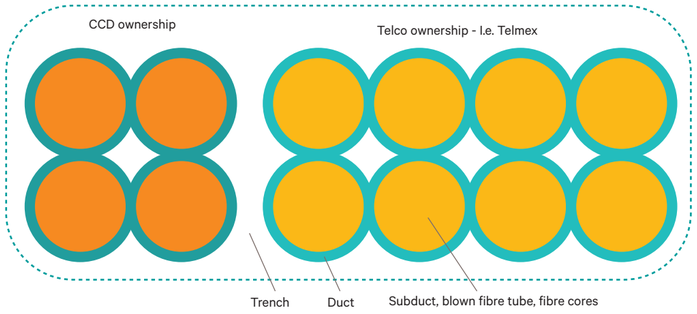
The cost of putting this infrastructure in place is relatively low since fibre connectivity is only required to a few of the access points.

CELLULAR NETWORK INFRASTRUCTURE

The area of the CCD will already be provided with cellular network coverage from existing telecoms providers, and thus it is not envisaged that further cellular infrastructure will be required. However a more detailed analysis of existing coverage and blackspots would need to be explored with the telecoms providers to understand whether additional infrastructure is required.

Extending the coverage of such a wireless network is relatively simple since additional access points can be added to existing street furniture without the need for extending the underlying fibre network.

A 4 duct private CCD network and an 8 duct commercial network would probably pro-vide enough capacity for CCD requirements.



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POTENTIAL B2B WIRELESS LAN INFRASTRUCTURE OWNERSHIP MODELS

Business Model	Description	Value Chain: Provide physical location for network	Value Chain: Provide physical infrastructure (Passive Network)	Value Chain: Provide access to communications (Active Network)	Value Chain: Maintain end-user relationship, billing etc.
"Hotspot" model	Privte operator builds and operates the WiFi network. The site owner strikes an agreement with operator to provide services to its customers	Site owner		Hotspot operator	
"Concession" model	Site owners builds and owns the Wi-Fi network, and offers a concession to operators to run, operate, maintain and wholesale capacity to service providers.	Site & infrastructure provider		operator	Service providers
"Wholesale" model	Site owner builds and operates the WiFi network, utilizing capacity for private use and wholesaling excess caacity to service providers / agregators		Wholesale provider		Service providers
"End-to-end" model	Site owner builds and operates the WiFi network utilizing capacity for private use and providing WiFi service directly to customers		Private end-to-end provider		

URBAN OS NETWORK LAYER

CCD Private Fibre Network:

CCD might want to run its own private fibre backbone network to provide wide area network connectivity between key CCD buildings and to support **utility services** such as smart parking, intelligent transport systems and smart grid systems.

Providing **security services** to the CCD is likely to be a very important issue in order to attract businesses and residents. A backbone fibre network would be required to provide the capacity for the video traffic from CCTV cameras across the CCD area.

In order to provide CCD residents with innovative ways of interacting with local information and services the extended use of digital kiosks and **urban informatics** will be required. A CCD fibre network will support a closer interaction with e-government services and visualisation of urban information such as energy consumption, water quality, air quality, traffic statistics, etc.

A **data centre** will be required for storage and analysis of information from multiple different CCD systems. The location for such a data centre has been suggested as being in the MMMM building, as described in the Sustainability Energy Strategy section of this report.

CCD WIRELESS MESH NETWORK

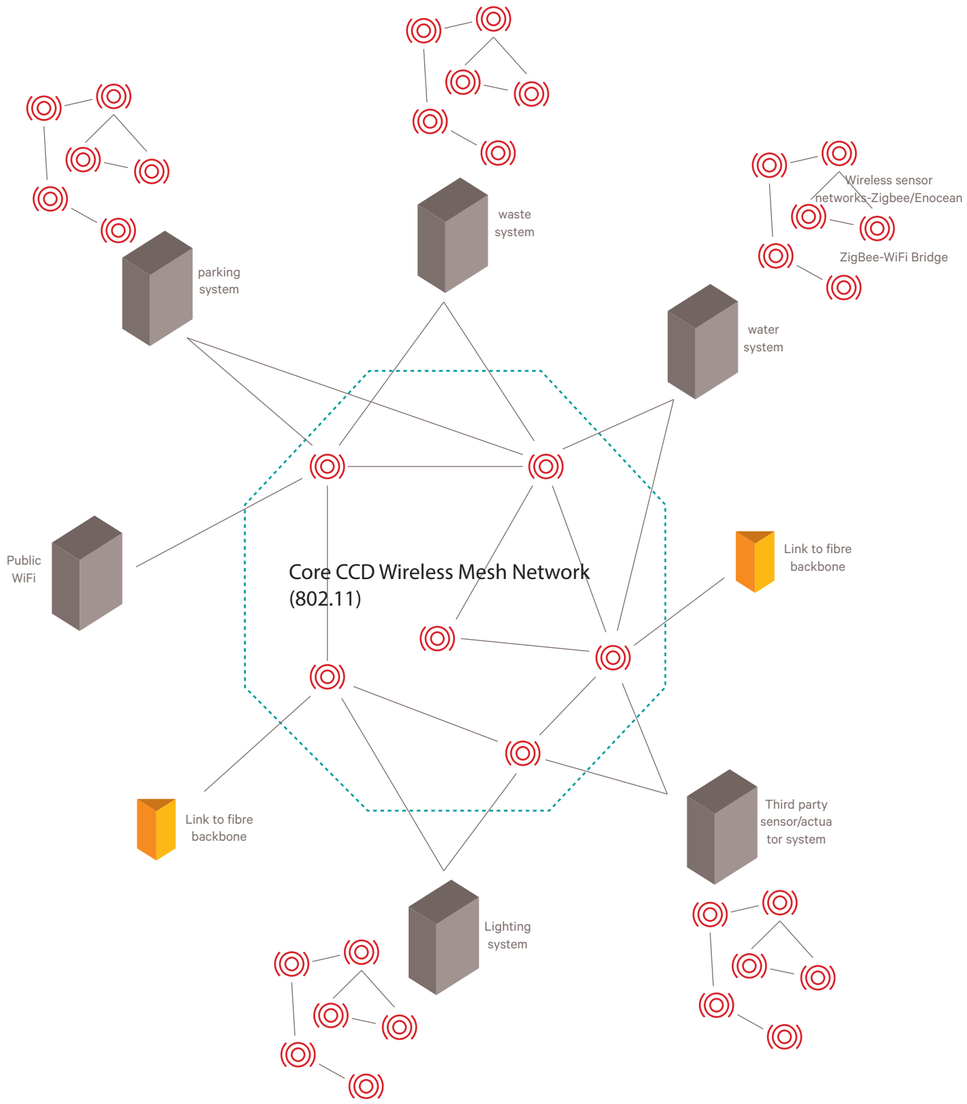
The CCD would provide an environment for multiple wireless mesh networks to operate:

- Core mesh network providing coverage throughout CCD
- Multiple localised mesh networks for providing different services such as smart parking

The core mesh network would potentially operate on the 802.11 family of protocols and would provide public internet access over wi-fi, as well as provide virtual LANs for transmitting signals from more localised networks such as smart parking.

Multiple mesh networks for localised services such as smart parking, operating on a protocol such as Zigbee or Enocean, could bridge into the core network in order to provide connectivity back to a data centre.

Wireless mesh networks provide resilience, self-healing, flexibility and scalability. Each node acts as a router, routing traffic through the network in the most efficient manner, and breaking down long distance communication into a number of shorter hops.



19

Urban Infrastructure: **Power & Electricity**

19.1.

Site Conditions and DUIS Requirements

SITE CONDITIONS

The existing electricy network within the CCD project area includes a substation and a mid voltage aerial distribution network.

Power Demand

TOTAL POWER AT LEVEL:	PHASE 0 kW	PHASE I kW	PHASE II kW	fdp	TOTAL kVA
CALC:	4.463	21.455	19.973	0,9	50.990
LOW VOLTAGE LINES:	200	300	300	0,9	889
TRANSFORMER SUBSTATION 23kV/240V:	2.798	12.296	11.312	0,9	29.339
MEDIUM VOLTAGE LINES:	2.378	10.451	9.615	0,9	24.938
SUBSTATION 69/23 kV:	2.259	9.929	9.134	0,9	23.692

DUIS REQUIREMENTS

The DUIS report consider 209.107 m² for CCD development, than is less than this Master Plan consider (574.800 m²). it Will be necesary a new study with the new surface of CCD + rest of DUIS development in order to confirm than the substation has enough reserve power for both development quatumns. If not, it is envisaged that as CCD hub will be the first of the DUIS development area to be implemented that the existing substation will provide enough power.

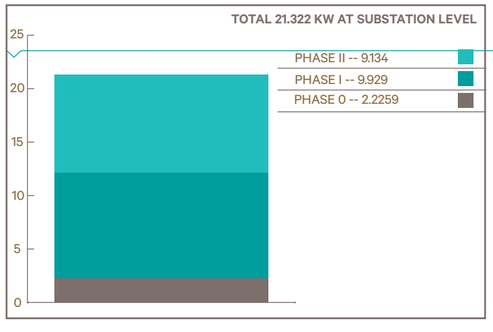
RATIOS	VIV./S_{EDIF} (m².e)
Offices	85
Comercial	150
Hotel	70
School	60
Residential	5750
Reccreation Facilities	150

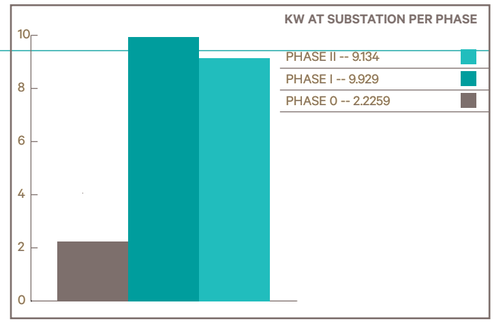
The existing substation (Alameda) has enough reserve capacity (30MVA) to supply the CCD hub development. It´s close location would make very efficient distribution pattern and potential looses or ineficiency can be addressed with an upgrade in the distribution network.

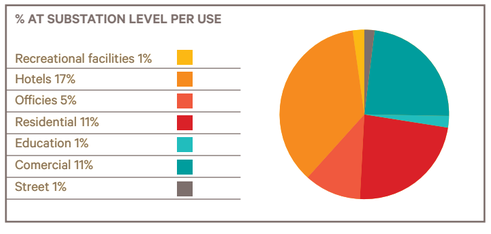
ELECTRICAL MV INFRASTRUCTURE EXISITING SITUATION

Substation

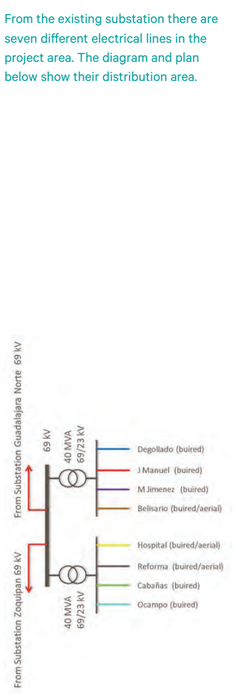
- Existing substation 69kV/23kV
- Conected to Substation Guadalajara Norte
- Back up from Substation Zoquipan
- Enough reserve power to supply new CCD development: 30 MVA
- Two 40MVA transformers 69/23 kV
- Eight diferents lines 23 kV on site







From the existing substation there are seven different electrical lines in the project area. The diagram and plan below show their distribution area.



Location of existing substation

19.2.

Constraints & Opportunities

CONSTRAINTS

- Air distribution network
- susbtation capacity for future DUIS development
- non existent conection route to other substations
- location of other substation off site

OPPORTUNITIES

- Upgrade on distribution network, buried
- allow to increase capacity on existing substation
- Compensate reduce on power demand from CCD with offsite back up supply

Existing Electrical MV infrastructure - MV distribution buried lines:

- Radial configuration (no rings configuration)
- Mix old and new lines
- Mix buried and aerial lines
- No back up reflexion centres

MV distribution of buried lines

MV distribution of aerial lines

19.3.

Proposed Physical Infrastructure

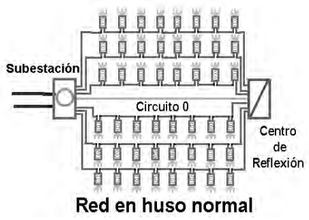
ELECTRICAL MV INFRASTRUCTURE PROPOSED

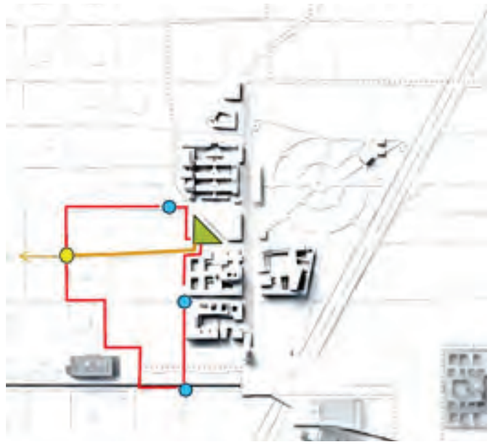
Substation:

- 69kV line to Alameda and to Zoquipan from diferents transformers in Guadalajara Norte Substation
- Buried all lines

MV distribution lines:

- Ring configuration
- Buried Lines
- Buired transformers
- Back up with cero circuit and reflexion centers





PHASE 1:
1 reflexion centre
3 substations

PHASE3:
2 substations

PHASE 2:
1 reflexion centre
10 substations

LEGEND
Alameda substation 69/23 kV
MV lines buried
Cero circuit buried (by an alternative route)
MV transformers (buried)
MV reflexion & distribution centres

ELECTRICAL LV INFRASTRUCTURE EXISTING / PROPOSED

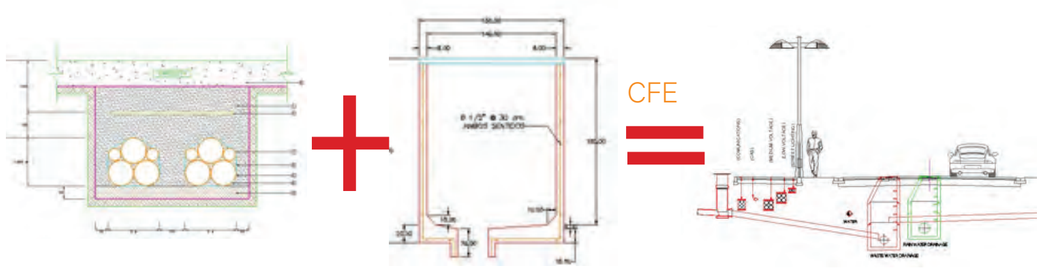
The current situation in the centre of Guadalajara shows the transition from aerial lines to buried lines for LV.
In the following plan, we have illustrated the approximate extent of the current situation that includes the area for CCD.

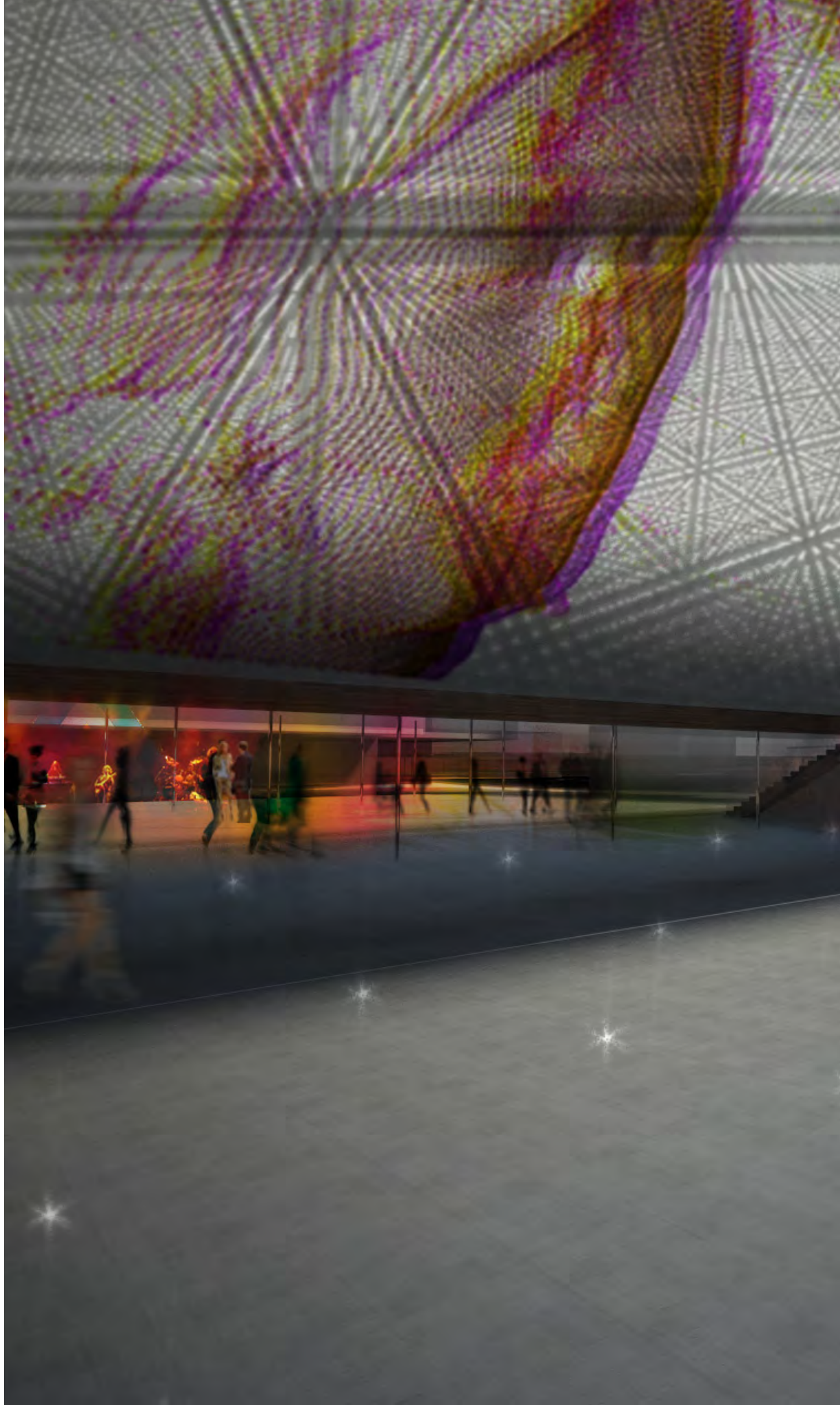
We would propose that all lines are buried (MV+LV+lighting), all transformer substation are buried. This would have the following benefits:

- more space in the public realm for users and pedestrians
- will provide a secure installation
- will have easy access and maitenance

Current aerial lines zone (approximate)

Current buried lines zone (approximate)





19.4.

In Detail: Street Lighting

EXISTING SITUATION

The exisiting street lighting in the CCD project area is in general very old, out of mexican current codes for performance, expensive to operate and expensive on maintenace by the municipality.

It is envisaged that CCD trust takes ownership of this service accross the full development area to ensure an upgrade program is rolled on.

PROPOSED SYSTEM

The proposal for street lighting is to implement a system with the following characteristics:

- CIE 129 code on site
- LEDs technology LEDs reduce lighting energy requirements by 50% or more, but their greatest benefit is that they last much longer than conventional bulbs, reducing operating and maintenance costs
- allowing remote monitoring and control
- allowing other information devices to be co-located in the luminarie (i.e. traffic, presence of people, security, etc)

REMOTE MONITORING AND CONTROL

Within CCD all street lighting monitoring and maitenance should be done using real time sensors and on line data provided buy the system and ursers. This will allow to reduce operating costs and be more efficient in terms of power consuption accross the site.

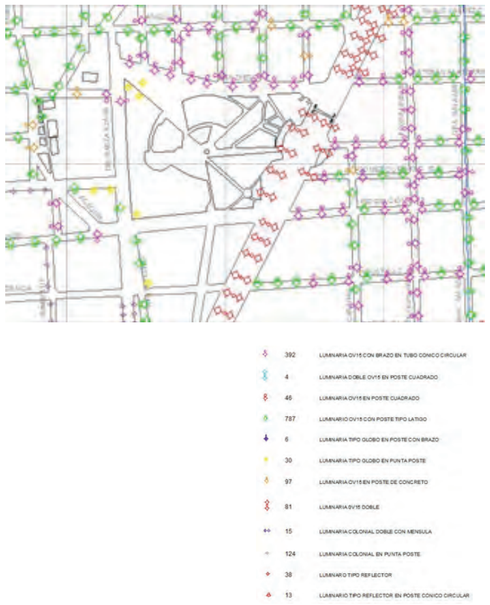
- Applying a tele management could save 1,700 hours of annual consumption, approximately 30% of annual consumption and emissions.
- Decentralised control adapted to each area: residential, road, industrial, etc.
- Luminaries with lighting dinamic control
- Ballast with double level
- Lighting sensors

INTELLIGENT STREET LIGHTING WITH SMART CITY INTEGRATION CAPABILITIES

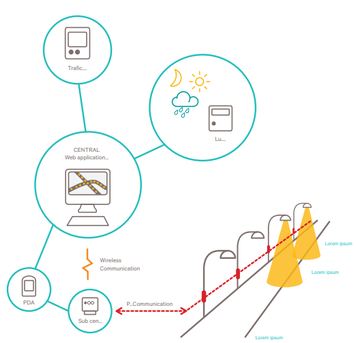
This implementation can reduce energy consumption by 70%

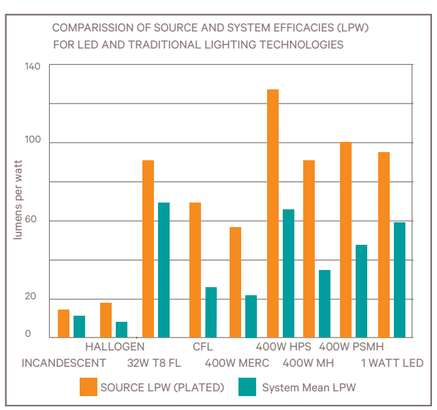
Advanced communications mean each lamp can be dimmed individually when traffic and climate conditions permit. This increases the life expectancy of lamps and equipment, generating huge economic and energy savings. Moreover, the power line transmission of data to a GIS-database containing information on every single fixture enables he operator to easily identify lamps that have or soon will burn out. This technology´s estimated to increase efficiencies by 30%.

Existing street lighting infrastructure



Intelligent street lighting control system





STREET LIGHTING FOR PHASE 1

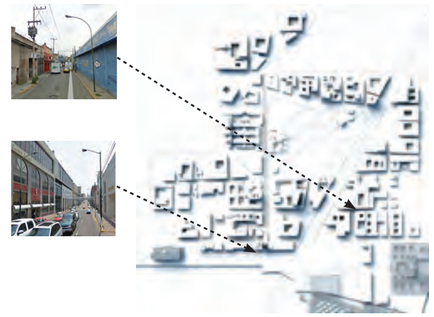
Applying a dinamic tele management could save 1,700 hours of annual consumption, approximately 30% of annual consumption and emissions.
Key principles for street lighting:

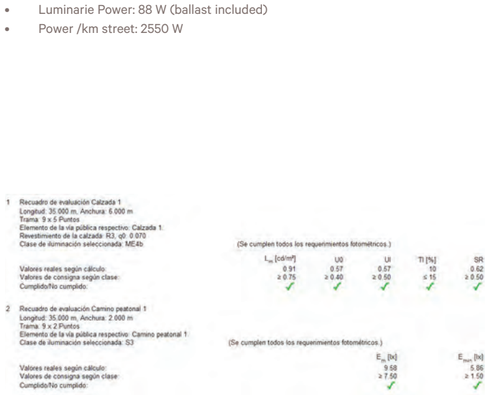
- Decentralised control adapted to each area: residential, road, industrial,...
- Luminaries with lighting dinamic control
- Ballast with double level
- Lighting sensors

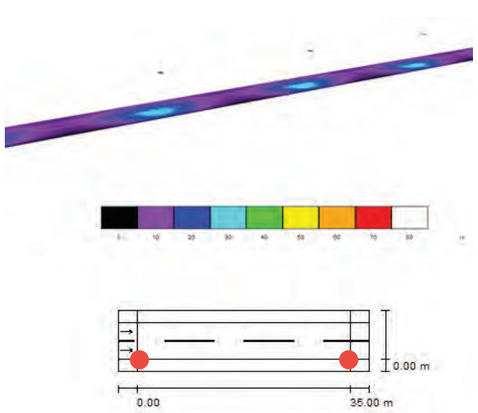
Case study 1: Calle Industria

Following the principles mentioned above, the type of street (CIE): ME4b for pathway and S3 for roadway, 10 meters width

- Led luminaries (INDAL LUMA 2R1 in the example)
- White light: More comfortable
- Luminarie Lumen: 8280 lm
- Luminarie Power: 88 W (ballast included)
- Power /km street: 2550 W





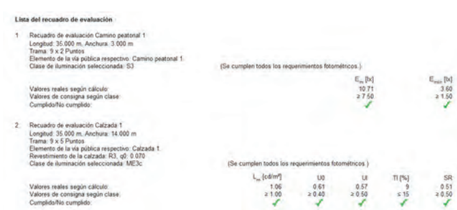


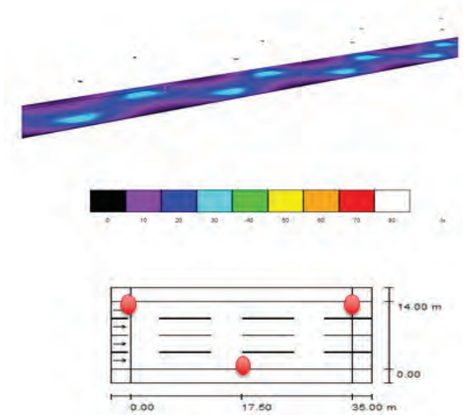
Street lighting proposal for calle Industria (narrow street)

Case study 2: Calle Repùblica

Following the principles mentioned above, the ype of street (CIE): ME3c for pathway and S3 for roadway, 17 meters width

- Led luminaries (INDAL LUMA 2R1 in the example)
- White light: More comfortable
- Luminarie Lumen: 10198 lm
- Luminarie Power: 109 W (ballast included)
- Power /km street: 6412 W





Street lighting proposal for calle Repùblica (wide street)

20

Urban Infrastructure: **Water Management**

20.1.

Site Conditions and DUIS Requirements

SITE CONDITIONS

The exisiting water supply network is old and inadequate as described in the Memoria tecnica of the DUIS. For the waste water collection the network is also old and it is operating close to peak capacity. There is the fundamental principle to update these basic infrastructure networks to provide a a reliable service for future development at CCD. Special mention deserves the current waste water system which is a combined system.

This does not allow for any on site water recycling neither collection of storm water. Therefore the proposal for water managment at CCD are aspirational as they will require a substantial ammount of investment on water infrastructure upgrade.

The last important element is the high water table level due to the site historical proximity to a river bed. There is a constant risk of flooding in the north side of Parque Morelos, when intense precipitation occurs. The flood is more the result of overflown from the main sweage system (located along Av. Independencia) than from the low topography on site. Nevertheless, the water strategy for CCD incorporates an intelligent system to mitigate both.

The water management strategies described in this chapter focus primarily on the implementation of Phase 1. With positive momentum from the work on Phase 1, some considerations for potential options for additional treatment and flood mitigation have been provided Phases 2 & 3.

Guadalajara is situated in south west Mexico; it has a population of 4.24 million covering an area of 2,734 km2. There are no streams or rivers found within 4 miles of the site. The site covers an area of approximately 40 ha (Phase 3 completion) that centers on the historic Parque Morelos.

The existing average climate in Guadalajara is not extreme but more temperate with humid summers that ar tropical.

- Dry, mild winters
- Warm, wet summers (June – Sept)
- Very strong seasonal variation in precipitation

DUIS REQUIREMENTS

The DUIS development framework has already address some of this deficiencies of the network but from a land use perspective and in particular for the housing element.

Among the key measures outlined by the DUIS in relation to improve water efficiency on residential use are:

Water consumption in CCD for residential uses

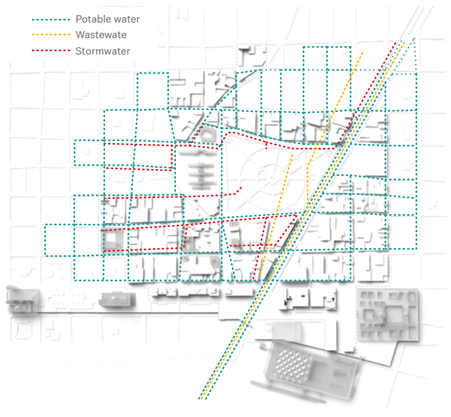
- Reduce consumption by 50%
- Recycle on site at least 50%
- Requirement to install sanitary features with optimized water consumption rates

For water consumption in CCD for non residential use DUIS does not state any provisions. There are a number of existing utilities within the proposed development boundary. There is evidence that a combined sewer runs along the Calzada Independencia Norte, although there is no available information regarding depth and diameter (however it is assumed to be large). Two more sewer lines are found, crossing through the Parque Morelos, one in the center and one in the north east area of the park.

Two potable water lines run parallel to the combined sewer along the Calzada Independencia Norte, and a significant network of potable water is evident in the surrounding streets from the park. There is a stormwater network running adjacent to the north, south and east boundaries of the park.

Site topography and flood risk area.
Source Fundacion Metropoli

Existing municipal water supply and waste water infrastructure network



20.2.

Constraints & Opportunities

WATER MANAGEMENT CONSTRAINTS

- No streams or rivers within 4 miles of site location
- combined sewage system in place
- No run-off locations in the city at present
- Close proximity to main transport routes

OPPORTUNITIES

- Historic Parque Morelos to be the center of the plan
- Transform this “creative city” to be a mirror of green infrastructure innovation
- To imitate the Ramblas and implement a similar intervention of pedestrian park space
- To incorporate green roofs on buildings facing the park to collect storm water

KEY ASPECTS TO TACKLE

The CCD project has the potential to mitigate the capital cost on water infrastructure upgrades by setting a high standard on capture and reuse water on site. This, combined with an increase Water recycling by building and land use and a reduce water consumption by building and land use will bring the requirement investment to be balanced between public and private owned funds.

The other main element would be to reduce Flood risk in public spaces –specially Parque Morelos by provide solutions for water management on site: The first green urban infrastructure in the city

At a building level, there are proven storm water strategies that could be implemented such as green roofs, disconnected downspouts and rainwater harvesting.

At a block scale level, the stormwater strategies could be: rain gardens, permeable pavement and micro-pools. Within the open space, stormwater strategies can be incorporated into Bioretention Systems, wet ponds, Wetlands and Extended detention basins. At street scale, the stormwater can be integrated in design elements such as infiltration planters, bio-swales, permeable paving and enchanced tree-pits.

20.3.

Overall Aproach to Water Management

20.3.1. Water management at building scale

The sustainable approach to reduce the water consuption on buiildings can be sumarized as follows:

- Strategies to use 20% less potable water use for buildings (not including irrigation)
- Reused or treated grey water for irrigation and non-potable uses
- Availability of different qualities of water for different uses in the building, at least two different qualities of water supply, one for toilets or urinals and one for water for human contact
- Rainwater will be stored for later filtering and reuse in irrigation and sanitation
- Surplus of rainwater (surpassing storage) shall conduct a soakaway which will infiltrate into the ground
- Decrease potable water demand by 50%
- Treat and/or reuse 50% of the wastewater in-situ
- Introduce species of low water consumption to reduce irrigation demand by at least 50%

FOR POTABLE WATER:

Efficiency lower than or equal to:

- Institutional-closing tap. Flow rate less than or equal to 0.95 L / min at a pressure of 5.5 bar or 80 psi.
- Low-flow showerheads. Flow rate less than or equal to a pressure of 6.8L/min 5.5 bar or 80 psi.
- Normal residential tap. Flow of less than 8.3 L / min at a pressure of 5.5 bar or 80 psi.
- Quality waterless urinals.
- Dual flush toilet under 6L (complete discharge) and 3L (average discharge) at a pressure of 5.5 bar or 80 psi.
- WC flush valve discharge 4.8L or less at a pressure of 5.5 bar or 80 psi.
- Kitchen faucet 8.3L/min under a pressure of 5.5 bar or 80 psi.

Key conventional cooking under pressure 8.3L/min to 5.5 bar or 80 psi.

FOR RAINWATER AND FLOODING:

We have assumed 3 different scenarios of green roof areas that would be implemented on every building at CCD during phase 1.

Scenario 1: To store for a 100yr event for 15% of the building parcels:

- 15% of building parcels = 480m3
- 100% capture from park and public (open) space = 1,080m3
- Total Flood storage required = 1,560m3
- Total Pond volume (Permanent + Flood Mitigation) = 4,100m3
- Assume pond depth of 2m, Surface area = 1,848m2

Scenario 2: To store for a 100yr event for 30% of the building parcels:

- 30% of building parcels = 960m3
- 100% capture from park and public (open) space = 1,080m3
- Total Flood storage required = 2,040m3
- Total Pond volume (Permanent + Flood Mitigation) = 4,580m3
- Assume pond depth of 2m, Surface area = 2,088m2

Scenario 3: To store for a 100yr event for 50% of the building parcels:

- 50% of building parcels = 1,600m3
- 100% capture from park and public (open) space = 1,080m3
- Total Flood storage required = 2,680m3
- Total Pond volume (Permanent + Flood Mitigation) = 5,220m3
- Assume pond depth of 2m, Surface area = 2,408m2

OVERALL TARGETS AND ASPIRATIONS.

To achive all the requirements stated by the DUIS and above so that CCD can become and exemplar development in terms of water management we have defined three key indicators to develop the overall strategy. These are:

- Reduce non potable water demand with recycle water
- Increase building water demand met with recycled water and,
- water discharge to the municipal service down

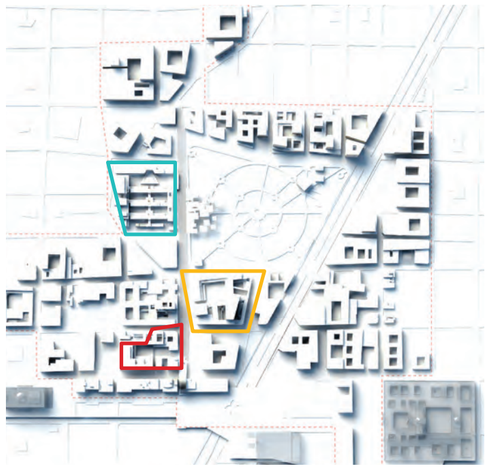
As stated in chapter 17, the water managment strategy contributes to the overarching sustainability vision of CCD. In addition, it contributes to reduce emissions from water discharge and recycle processes.

Fundamentally, the on site water recycle is made from two key design measures:

1. At a building scale through the incorporation of green roofs and,
2. At a site wide scale through the design and implementation of a series of water retention ponds in Parque Morelos.

The latter will also contribute to mitigate the existing flood risk in the area.

Legend:
15% of building parcels
30% of building parcels
50% of building parcels



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20.3.2. Water management in public spaces

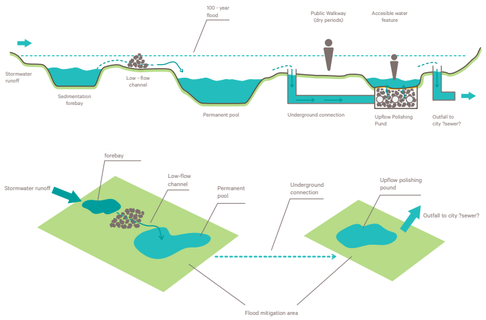
PHASE 1 STRATEGY

Introducing a stormwater pond in Parque Morelos presents an opportunity to accomplish multiple functions including: flood mitigation, water quality improvement, park amenity and even managed public recreation. To achieve all these functions, multiple treatment stages are recommended:

- Pre-Treatment – sedimentation forebay;
- Primary Treatment – permanent vegetated pool;
- Polishing pond – final stage of treatment, will be accessible to the public providing additional amenity value to the park.

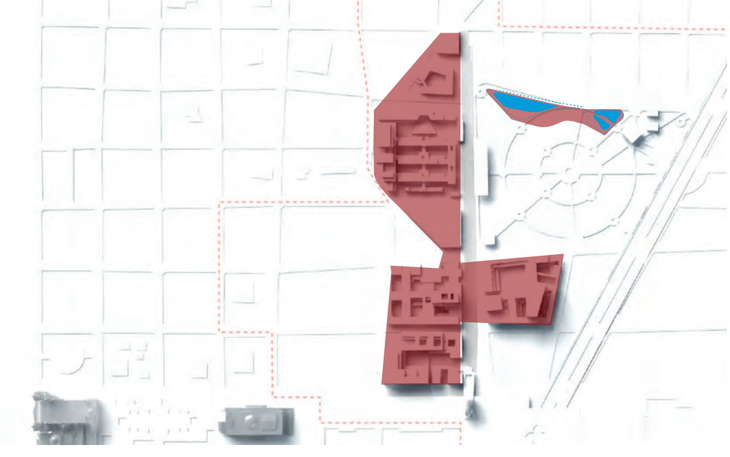
Primarily focused on the land Parcels to West of Park and link with a new storm water network to the pond area.
Total Area of Phase 1 = 10.2ha
Land Area treated = 3.86 ha
37% of land area treated in Phase 1
10.4% of land treated in Phase 3

Buildings within parcel to the West and Pavillion
Total Building Area (Phase 1) = 2.3ha
Building Area in = 1.25ha
53% of building area in Phase 1



Phase 1	Area (Ha)
Total Phase 0	10.2
Land Parcels	2.64
Pond Area	1.22
Total Impervious*	3.86

illustrative plan of the phase 1 green roof zones and stormwater discharge to pond



ADDITIONAL FLOOD STORAGE VOLUME

Parque Moreles has a history of flooding, therefore the introduction of flood mitigation measures within the multi-stage stormwater pond has been proposed. The water level in a wetland system can increase up to 1 metre after a storm event, returning to normal levels within 24 hours.

The atenuation pond in Parque Morelos would potential mitigate the risk of flooding if the flood area (seasonal) is extended. It would be composed of 3 sections: Sedimentation forebay will capture the incoming stormwater reducing peak stormflow volumes. This forebay will also provide the first form of treatment, capturing large, coarse sediments.

From the forebay, stormwater will trickle horizontally through a riprap stone where it will then flow into a low-flow bio-swale where the stormwater will experience nutrient removal, sedimentation of finer particles and aeration through movement. Flow from the bio-swale will enter the permanent pool which will provide vertical storage, remove pollutants through biological processes and reduce the space required for the system.

The polishing pond will be the final form of treatment relying on hydrostatic pressure to cause upflow through natural filtration media into this pond. The pond may also provide additional flood storage for stormwater..

According to the US EPA, A handbook of constructed wetlands, Volume 5:Stormwater, the sediment forebay and the permanent pool can be up to 2 metres deep, and comprise at least 10% of the stormwater volume.

If this would be the case the summary table for phase 1 would be:

- 100 year storm event
- Runoff for land parcels = 47.5mm
- Runoff for Pond Area = 15.84mm
- Total additional storage volume required for impervious area = 1,450m3

	Area (m2)	Depth (m)
Available Flood Area 1	2270	0.6
Available Flood Area 2	780	0.2

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20.3.3. Aspirational targets

WASTE WATER TREATMENT BY 50%

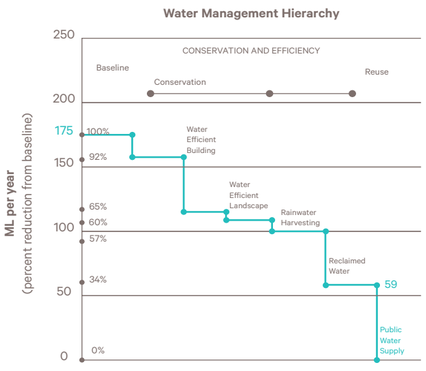
REDUCTION THROUGH WATER REUSE

70,6 % Site Water Demand met with RWH

80,0 % Total Non-Potable Demand met with Reclaimed Water

36,1 % Bldg Water Demand met with Reclaimed Water

42,5 % Reduction in Wastewater Discharge



WASTE WATER TREATMENT 0%

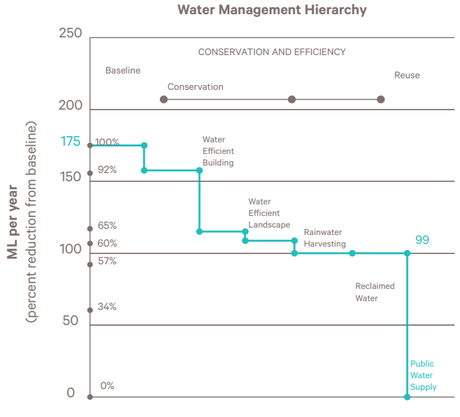
REDUCTION THROUGH WATER REUSE

70,6 % Site Water Demand met with RWH

14,3 % Total Non-Potable Demand met with Reclaimed Water

0,0 % Bldg Water Demand met with Reclaimed Water

0,0 % Reduction in Wastewater Discharge



20.4.

In Detail: Water Collection On-site

TREATMENT AND FLOOD VOLUMES REQUIRED FOR PHASE 2 AND 3

Phase 2 covers an approximate area of 37.07ha. Assuming that a similar multi-stage stormwater pond could be implemented, the treatment volume and pond areas found in Table 5 were calculated for the land parcel east of the park that will be developed in phase 2. This land parcel includes buildings from phase 1 and phase 2 therefore a phased approach for implementing the full treatment pond system may be required.

There are two possible options for the placement of the stormwater ponds.
As the land parcel is east of the Parque Morelos, on the opposite side of the Calzada Independencia Nort. The Calzada Independencia Nort is a primary transport route running adjacent to the park andalso has a number of utilities located within it; this increases the difficulty of crossing this route.

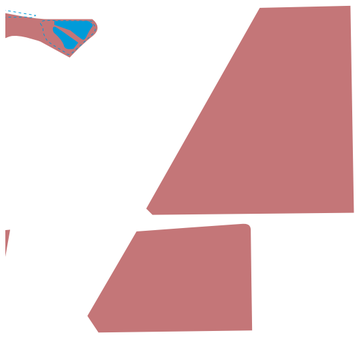
ALTERNATIVES FOR STORM WATER TREATMENT ON SITE FOR PHASE 2 AND 3

The second alternative would explore to replicate the same strategy used during phase 1: reduce water consuption at building level so that there is a very small ammount of wate water requiring treatment. In this alternative a new set of attenuation and treatment ponds would be located in the park or adjacent to Av. Independencia. See diagrams below.

This continues with the idea of incorporating water features into the evolving design of the masterplan.

Water managment -phase 2 and 3
Ponds in the park
Land parcel east of park (2.1ha approx.)
Potential Dual Use: Recreational v Flood detention
Only wet during storm events
Detention basin

Volume required for Treatment (WQV) (m3)	650
Treatment Area Required at 1.2m depth (m2)	540
Flood Volume required for 100yr Event (m3)	1010
Flood Area Required at 0.4m depth (m2)	2525



KEY CHALLENGES OF THIS ALTERNATIVE ARE:

- Area is low point of park, common to flooding which is assumed to be contaminated by CSO.
- Potential to create a physical barrier, e.g. a bund
- Strict clean up regulations may be enforced
- If proposed area is used for water feature, difficulty in crossing primary transport route to reach the park
- Two potable water lines, large combined sewer and storm water lines
- Opportunity to create a dual-purpose area (Recreational vs Flood)
- As the land parcel is within phase 3, the water feature would not be implemented/in use until then

A second alternative would be to not create a water feature in the park itself for the reasons described above but on the other side of Av. Independencia.
Land parcel east of park (2.1ha approx.)
Treatment ponds in public space area within land parcel
Flood area still within the park boundary

Within Public Space in Land Parcel

Volume required for Treatment (WQV) (m3)	650
Treatment Area Required at 1.2m depth (m2)	540

Within Park Area

Flood Volume required for 100yr Event (m3)	1010
Flood Area Required at 0.4m depth (m2)	2525

As described previously, the water managment strategy for public spaces incorporates during phase 1, the creation of a new attenuation pond in the park to receive stormwater from builidings and eventual flood risk in the park it self. Therefore the on site water collection and recycling process will start duing phase 1 but won´t achive the desirable target of on site water recycled until phase 2 is completed. At this point, there will be enough volumen of treated water to invest in one of the alternatives described below.

ALTERNATIVES FOR WASTE WATER TREATMENT ON SITE FOR PHASE 2 AND 3

We have evaluated 2 alternatives to manage on site at least the DUIS requirement of above 60%. This requires a bold approach in terms of reducing water consuption wich we have described previously but still a substantial ammount of waste water needs to be treated.

The first alternative is bold and it requires a substatial capital investment. It is not new in some European cities where Sustainability is on the agenda. This would propose to have an on site waste water treatment plant to treat all 50% of wastewater in three different scenarios:

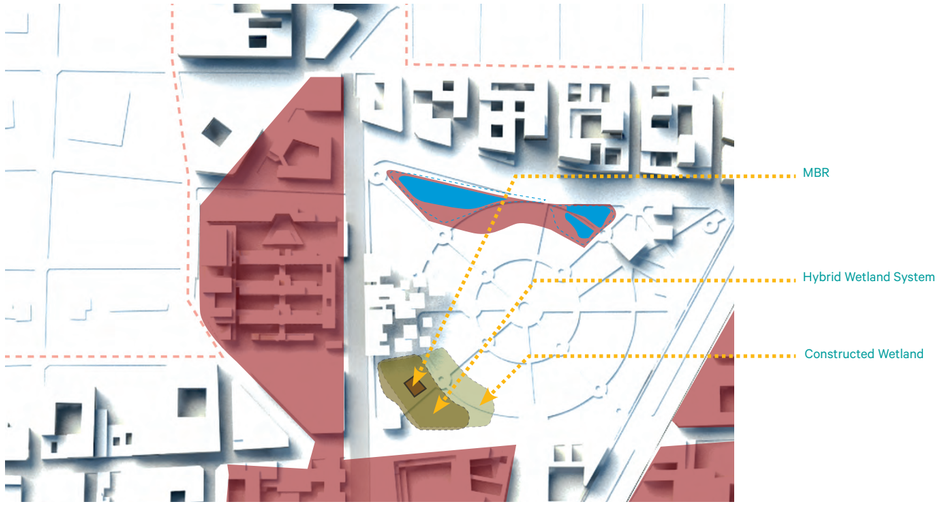
Three potential ideas for this would be:

1. MBR
Estimated Footprint = 277m2

2. Hybrid Wetland System
Estimated footprint = 2,321m2

3. Constructed Wetland
Estimated Footprint = 3,529m2

The only realistic location would have to be in the park. The exact locaiton would need to be further analysed but it would not take a substantial ammount of land.



20.5.

In Detail: Water Infrastructure On-site

There are a number of measures to be implemented within this water strategy to reduce overall water demand within the site. These measures aim to meet the DUIS sustainability proposals.

BUILDINGS

Within all of the buildings, commercial, institutional and recreational, a number of conservation methods will be implemented. These methods include public education, leak detection technologies and compulsory metering and it can be assumed that they will cause a reduction of approximately 9% from the baseline demand.
Water efficient design will be implemented in all buildings within the development. This will include water efficient plumbing fixtures and other water-saving devices. This is assumed to generate a 30% reduction from the baseline demand.

It is assumed that green roofs will be implemented at all phases at either 50% or 70% roof coverage. In phase 1 this will account for approximately 29% of all buildings, in phase 2 (including phase 1) this will account for approximately 75% of all buildings, and upon completion of phase 3 (including phase 1 & 2) this will account for approximately 51%.

Green roofs provide treatment to storm water, making it available for reuse. In addition, it could be possible to enhance the green roofs to accommodate flood mitigation, capturing and treating larger storm events.
Rainwater harvesting will be implemented, which will be used to meet non-potable site demand.

PUBLIC SPACE

The landscape area, in phase 1, is assumed to consist of 50% of hardscape areas, approximately 1.48ha; this excludes the Parque Moreles. The landscaped area will require irrigation which will be met with non-potable water, at an efficiency of 75%. Achieving this efficiency would require evaporation losses to be minimized through scheduled irrigation, the use of native plants that are tolerant of local soils and climate conditions and landscape design that would priorities water efficiency.

Rainwater harvesting will be implemented on 37% of the area of phase 1, collecting from 60% of conventional roofs and 50% of landscaped areas. The maximum storage capacity will be 1,000m3 and will be used primarily to meet site water demand, meeting approximately 61% of the irrigation demand annually.

Stormwater treatment ponds are proposed to be located within public space areas; these also include additional flood mitigation measures. These ponds will be collecting and treating stormwater from surrounding land parcels that are mixed use.

WATER SUPPLY INFRASTRUCTURE

As previously shown there are existing utilities within the site. The existing potable water supply network appears to be adequate; therefore it would be advised to utilize the existing water supply network. Some upgrades and modifications may be required, as there are no known depths or diameters of the existing network.

WASTEWATER INFRASTRUCTURE

From the same plan it is evident that there is a large combined sewer running adjacent to the Parque Moreles. There is also evidence of two additional sewers within the park boundary. Aside from these primary sewers, it is assumed that there is a substantial sewer network mirroring the existing supply network.
The proposed sewer network will be dependent on the chosen form of wastewater treatment. If the large WWTP, under current construction, is used for wastewater treatment from the development then the proposed wastewater network would mirror the existing supply network, connecting to the large combined sewers found adjacent to the Calz Indenpendencia Norte.

Alternatively, if 50% of wastewater treatment is to be done on site then additional pipework would be required to connect to the chosen treatment method.

The plan (opposite) Proposed Infrastructure Required shows the proposed infrastructure that would be required for the development. Assuming that a 50% wastewater treatment will be treated on site, it would be least intrusive to offset from the existing combined sewer.

The plant will be sized to accommodate 50% of the wastewater generated within the development, however to minimize pipework required, it will offset the equivalent from the main city network. This treated water will be used within the development for non-potable uses, these buildings will have dual plumbing systems implemented.

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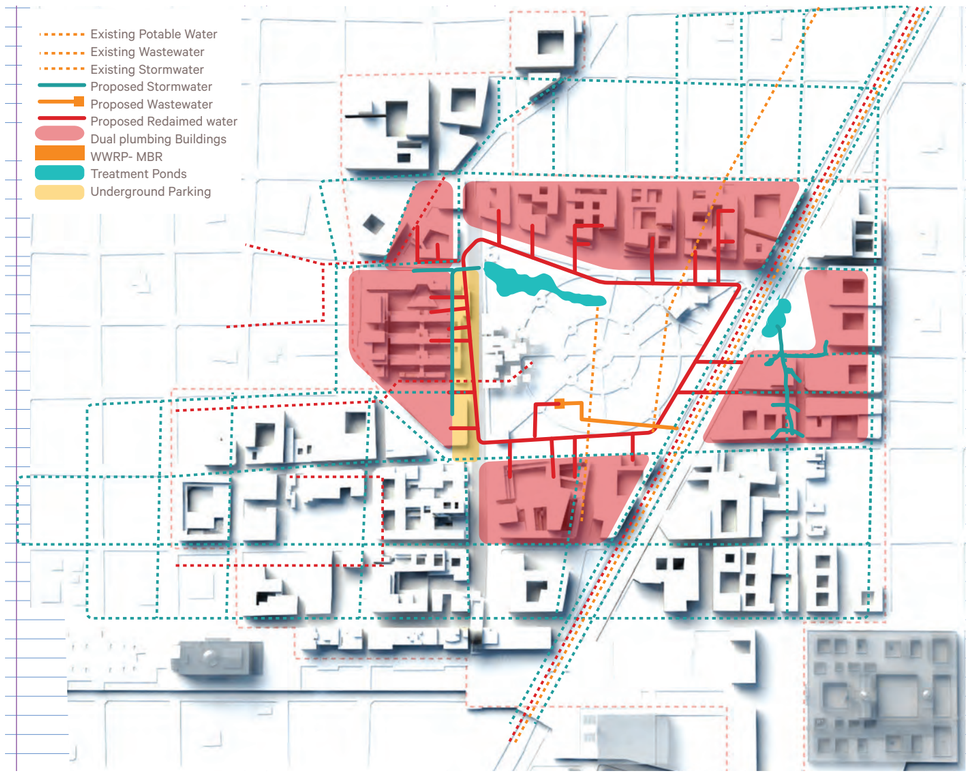
illustrative diagram of future stormwater and waste water network



20.6.

In Detail: Green Roofs

The water managment strategy in CCD at a building scale aims for a compromise that all new buildings should consider the incorporation of green roofs additional to permeable areas at ground level. The detail design of the former, should incorporate local planting, and considerations to be part of the accesible public zones of the building but fundamentally should incorporate systems for rain water collection. At this stage of the masterplan we have considered to principles to be applied to establish parameters for the green roofs.

PARTIALLY BUILT OUT PARCELS

This is the majority of the exisiting parcels within the CCD project boundaries.It is also the current situation where exisiting buildings with historical or heritage value are, and therefore the approach for these plots is less restrictive in terms of areas required to comply with green roods. therefore we proposed that in this parcels there is a combination of green roofs and rain gardens within the public space

FULLY BUILT OUT PARCELS

This would be very few parcels in the CCD project area. We would propose that these new purpose buildings have specific definitions and requirements for their green roof compliance. Green roofs is a requirement and would take up to 70% of roof space. During the next phase of design of the masterplan, this specification should be further developed in conjunction with the emerging architectural concepts.

In fully built out parcels, the only method of capture and treatment available is to implement green roofs. Partially built out parcels will allow for a combination of green roofs and rain gardens located within the public space.

For the purpose of this report, two land parcels that were investigated for required green roof cover. A number of assumptions were used to calculate green roof cover percentage, including;

- Total roof area is available to implement green roof
- Depth of growing median = 3 inches, media porosity = 0.25
- Depth of drainage layer = 3 inches, drainage layer porosity = 0.3
- Rain gardens would have maximum depth of 1 ft
- Fully built out parcel is one building, covering the entire area of the parcel
- Partially built out parcel contains a minimum of 20% public space area within the parcel.

Following the calculations on two sample parcels within the developments, the following assumptions can be made:

- If the land parcel has >20% public space, 50% green roof can be applied, with 12% rain garden space; or,
- If land parcel has <20% public space, 70% green roof can be applied.

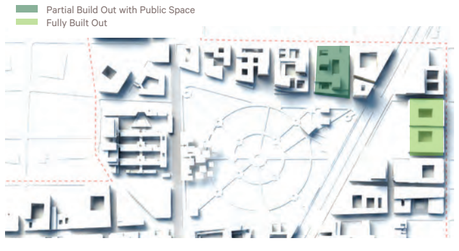
GREEN ROOF ESTIMATE: FULLY BUILT OUT PARCEL

Building area(ft²)	41,578
Water Quality Volume (ft³)	4,115
Green Roof Area Required (ft²)	29,927
% of Roof Required	72%

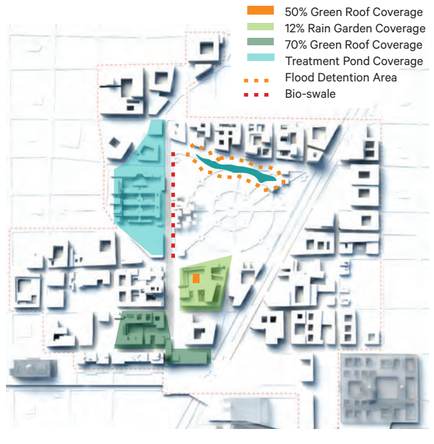
GREEN ROOF ESTIMATE: PARTIALLY BUILT OUT PARCEL

Building Area (ft²)	36,617
Public Space area (ft²)	10,120
Water Quality Volume	3,695
Green Roof Area Required	18,309
% of Roof Required	50%
Rain Garden Area (ft²)	1,178
% of Public Space Required	12%

Examples of partially built and fully built parcels.



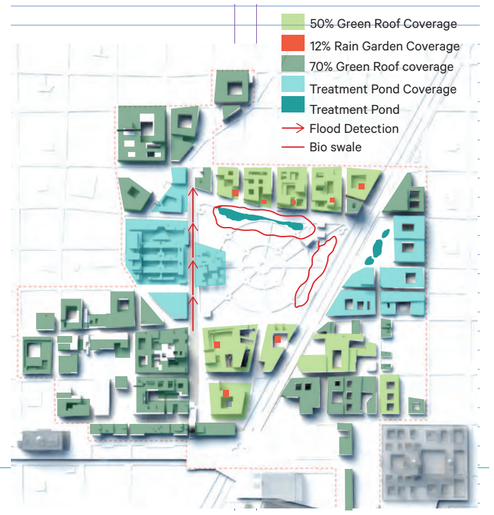
Phase 1 stormwater plan and green roofs requirements



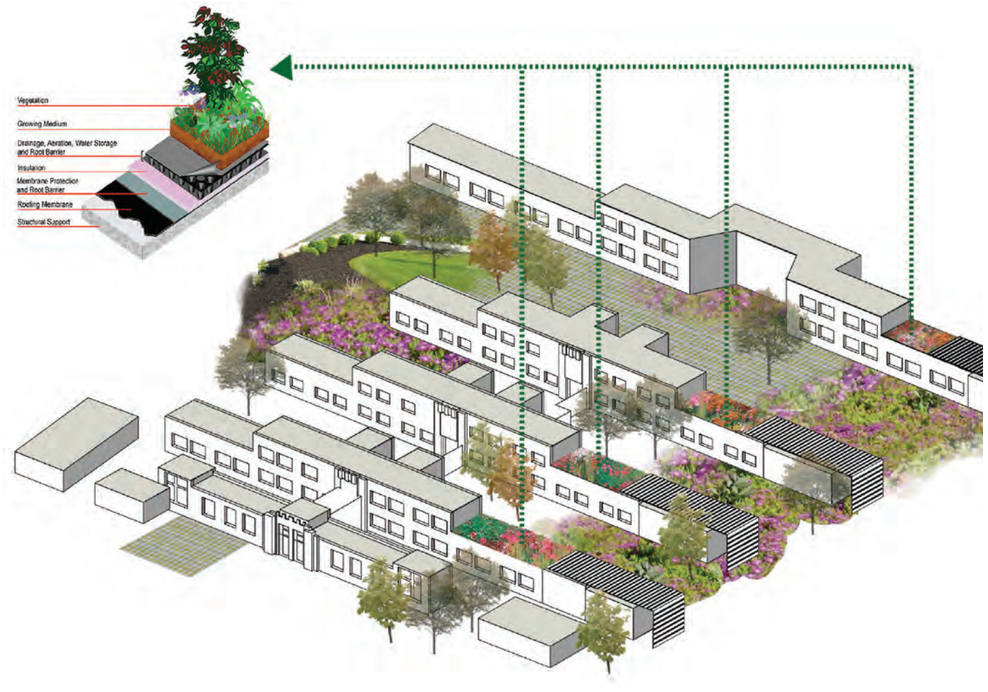
When CCD is completed by phase 3, and fully implemented, building-level stormwater strategies, the percentage of stormwater treated increases from:

- 37.8% to 62.7% in Phase 1
- 16.1% to 47.4% in Phase 3

Approximate Building Footprint (m	47.286
Building footprint captured by Treatment Ponds	8.340
Total Roof Area at 50% Green Roof Coverage	4.638
Total Green Roof Coverage achieved at 50%	2.319
Total Roof Area at 70% Green Roof Coverage	34.308
Total Green Roof Coverage	24.016
Total Combined Green Roof Coverage archived	26.335
Total Conbined Green Roof Coverage achieved	56%



illustrative example of green roofs incorporated in the existing school building.



21

Urban Infrastructure: **Waste Management**

21.1.

Site conditions and DUIS requirements

SITE CONDITIONS

The exisiting waste managment service in Guadalajara operates by sidewalk with most of the wast going to land fill. The "los Laureles" landfill it is estimated will reach capacity in 7 years. At present, the city authorities are preparing a plan to commence extraction of biogas from the landfill.

The main characteristics of the waste collection are:

- Sidewalk" collection done by CAABSA EAGLE using 8 ton trucks. They have the waste management concession for all of Guadalajara.
- NAE-Semades-007/2008 mandates the separation of waste.
- Majority of waste is disposed at Los Laureles landfill.
- Municipalities of Guadalajara, Tlajomulco de Zúñiga, Tonala, El Salto and Juanacatlán pay CAABSA EAGLE Peso 400million/year for waste management.
- Generators of waste do not pay.

DUIS REQUIREMENTS

The DUIS development framework has already address some of this deficiencies of the waste managment process.
Among the key measures outlined by the DUIS in relation to improve waste collection and managment are:
DUIS document B10 states that the CCD area will generate 3957kg/day of waste from 5200 newcomers

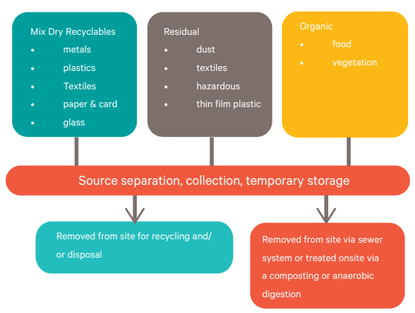
The DUIS waste strategy focuses on the following:

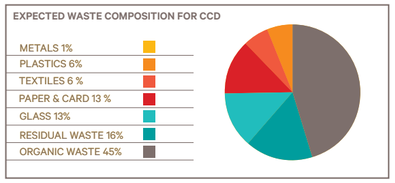
- Waste prevention and education. This is excellent and should be encouraged
- Separation of organic and inorganic wastes
- Door to door collection using small trucks or residents can bring the waste to collection points (see map)
- DUIS propose onsite composting
- Education is vital

However the DUIS do not make any initial recommendation in relation to construction & demolition waste management.

WHAT TYPES OF WASTE?

CCD is expected to generate 3657 kg/day (1335tonnes/yr) within the project area. This could change if the residential popullation increase. Although CCD will be a industry based development, still organic fraction is the largest. However there are opportunities to treat waste on site that will be presented in the next sections.





DUIS proposed facilities for on site waste managment

21.2.

Constraints & Opportunities

RESOURCE & WASTE MANAGMENT CONSTRAINTS

- Expected waste composition in CCD (future trents, industry shifting behaviour)
- BaU business for waste collection. i.e. it is a municipal service
- Some concesions on collection and waste to energy
- lack of policy framework to regulate informal economy of collectors

OPPORTUNITIES

- The CCD development quantum allows a better future waste generation estimate
- if CCD as a trust can own the waste managment procurment it could be a revenue stream
- Easy to implement strategies for prevention, reduction and reuse of waste

Green procurement

When establishing procurement contracts consider environmental, social and economic impacts

- Rethink the need for what you want to procure (can it be provided as a service in stead?)
- Reduce – can you use less of what you have?
- Reuse – can you/your supplier reuse what is procured?
- Recycling – ensure contractors enhance recycling of what you dispose
- Energy Recovery – what can't be reduced, reused or recycled should be treated to recovery energy if possible

when considering your procurement strategy think about the whole life cycle and that will happen to products when they reach their end of life.

Examples of green procurement

- Purchase wood from sustainable sources
- DON'T purchase products that contain hazardous substances. For example refer to the living building Materials Red List*
- Purchase products and services from companies that work to protect the environment
- Purchase products that are made from recycled content

Prevention, reduction & reuse

From other similar project worldwide, the biggest opportunity on waste managment would be in aplying these measures from the outset.

- Design buildings with deconstruction in mind (plan for how the building will be replaced at its end of life).
- Design internal spaces that are versatile. This will enable space change with minimal waste generation.
- Consider off site manufacturing of building components that are then fitted together on site. This reduces site waste generation.
- Use materials, packaging etc that can be easily recycled.
- Reuse products where possible, one persons waste can sometimes be another's resource.
- Set up a recycling and reuse network within CCD.

When considering your procurement strategy think about the whole life cycle and that will happen to products when they reach their end of life.

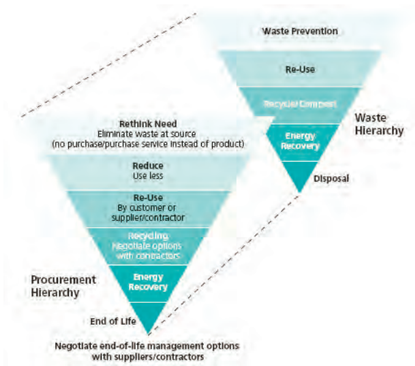
TR = Total Recycled Content
PC = Postconsumer Material Content

Glass Products	50% TR & 10% TC
Paint	50% PC
Solvents	70% PC
Tires	50% TR & 10% PC
Paper products	50% TR & 10% TC
Plastic Products	50% TR & 10% PC

examples of common products that contain recycled content

Home and office	Building & Construction Materials
Paper	Plastic wood
Plastic bags	Steel framing
Toner cartridges	Aluminum
Pens, pencils, scissors & rulers	Roofing, wallboard, flooring
Cardboard containers	Paint
Compost	Carpeting, tiles and matts
Cleaning supplies	Playground equipment

the green procurement hierarchy



21.3.

Overall masterplan approach

21.3.1 Objectives and aspirational targets

GENERAL OBJECTIVES
If CCD wants to become an exemplar sustainable development it should adopt the following:

- Enable CCD to become a catalyst for change in the region.
- Manage the use of resources in an integrated manner, producing minimal waste and promoting the sustainable use of natural resources and materials.
- Link CCD's future solid waste management strategy to the City of Guadalajara.
- Seek integration into and/or enhancement of existing/planned solid waste management infrastructure in the City of Guadalajara.
- Maximize Synergies with wastewater treatment and with other local waste generators.
- Education on all of the above will be vital
- Educating residents and workers about any new solid waste management initiative will be crucial to its success.

For this first 5 objectives the targets would be:

Overall diversion from landfill disposal
Short-Term – 70%
Medium-Term – 80%
Long-Term – 90%.

100% collection of all wastes

Waste diversion participate rates
Organic - 80%
Cardboard - 90%
Glass - 90%
Mixed Recyclables - 80%

For the last 2 objectives the targets would be:

To decouple the typical link between an increase in economic prosperity and an increase in solid waste generation.

To treat organic resources from waste using on site systems. This could be approximately 40%.

In terms of overall strategies the CCD concept masterplan should adopt these are:

Non-Spatial Strategies
Key drivers of change:

- Waste Hierarchy
- Circular Economy
- Green Procurement
- Recycled Content
- Waste Minimisation & Management
- Producer Responsibility

Spatial Strategies:

- Internal & External collection/storage points throughout the site.
- Pneumatic & conventional collection systems.
- Centralised organic waste treatment facility

In the next section we have identified the alternative technologies that exist in the market which CCD can implement to become a competitive digital hub. These solutions will required further detail feasibility studies at the next stage of design. At this point, it will illustrate on each proposed technology how they will address the 5 key aspirational targets described previously.

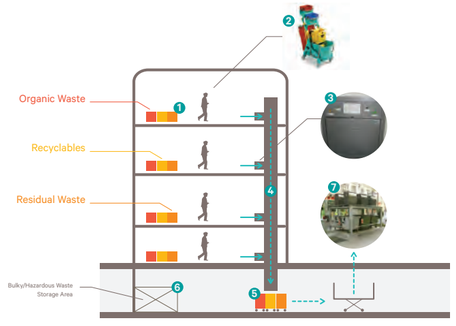
21.4.

Alternative technologies

The following alternatives have been developed for the full CCD concept masterplan developed across a period of 12 years. Each technology has been tested in other cities.

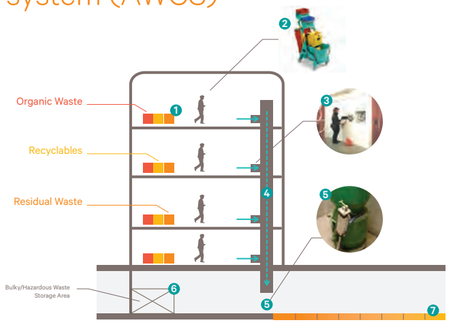
The alternatives have been ordered from the scale perspective being the first the one operating at the building level and gradually becoming an alternative that operates at a block level and at a district level.

Alternative 1:
collection & storage - gravity chute system to basement



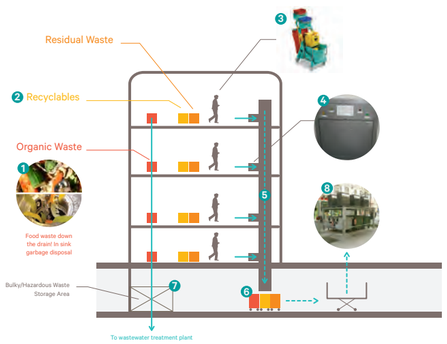
1. Source separation of waste by residents/office workers
2. Door by door collection of waste by janitorial staff
3. Janitorial staff deposit waste in chute
4. Waste travels down chute
5. Manual or automatic separation of waste
6. Separate storage for bulky and hazardous waste (this waste can't go down the chute)
7. Hydraulic lift brings waste containers to street level for collection

Alternative 2:
collection & storage - option 2 automated waste collection system (AWCS)



1. Source separation of waste by residents/office workers
2. Door by door collection of waste by janitorial staff
3. Janitorial staff deposit waste in system
4. Waste travels down chute
5. Waste temporarily stored on discharge valve
6. Separate storage for bulky and hazardous waste (this waste can't go down the automated system)
7. Conveyance of waste via suction to collection station (up to 1mile away)

Alternative 3:
collection & storage - option 3
Hybrid or Options 1 & 2

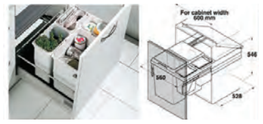


1. Source separation of food waste by residents/office workers and disposal using in-sink garbage disposal units
2. Source separation of recyclables and residual waste by residents/office workers
3. Door by door collection of waste by janitorial staff
4. Janitorial staff deposit waste in gravity chute
5. Waste travels down chute
6. Manual or automatic separation of waste
7. Separate storage for bulky and hazardous waste (this waste can't go down the chute)
8. Hydraulic lift brings waste containers to street level for collection

Indicative layout of AWCS pipes

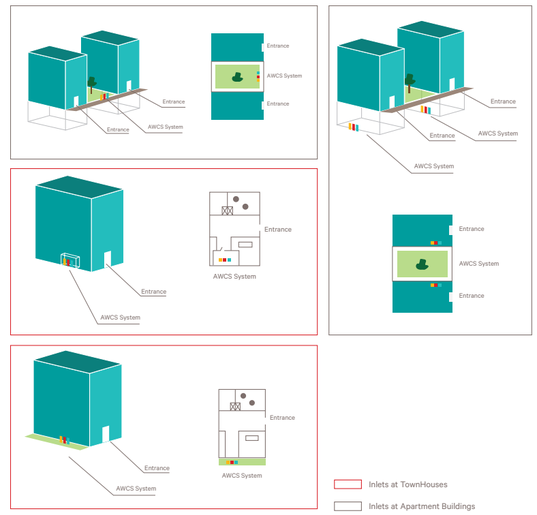
COLLECTION & STORAGE EXAMPLESINTERNAL & EXTERNAL

INTERNAL COLLECTION CONTAINER



EXAMPLES OF INTERNAL ORGANIC WASTE STORAGE

AUTOMATED WASTE COLECTIONS INLET LOCATION



PUBLIC AREA WASTE COLLECTION

CCD public realm aims to become a mix of digital workplace environment and responsive sensoring to interact with the user in real time. In terms of the resource and waste managment on site, and the collection of waste in public spaces our initial assesment demonstrates the opportunity to "hide" most of the heavy infrastructure associated with waste storage underground at specific locations with an underground hydraulic system.
This will have the following advantages:

- Waste is stored temporarily underground and out of site
- More storage leads to less frequent collections
- Vastly improved aesthetic appeal
- No need to change the type of bins used

In addition to the above, there are existing proved technologies to incorporate solar compactors bins as part of the public areas waste collection system. The have the following characteristics:

- Powered by the sun with inbuilt SMART wireless system
- Automatically compact waste which reduces frequency of collection
- Can communicate wirelessly to indicate how full it is and when it needs to be emptied
- Can result in collection cost reduction due to less frequent collection

21.4.1 Key recommendations

GENERAL OBJECTIVES

If CCD wants to become an exemplar sustainable development and at the same time truley showcase an urban environment where people can work everywhere in the public space, in terms of resource and waste managment, conceptually CCD should embrace the idea that waste is a resource and therefore should try to:

1. **Capitalize on the waste generated by the CCD**
2. **Increase gradually the overall diversion from landfill disposal and,**
3. **In the short term become a place for testing technologies on organiw waste disposal through anaerobic digestion at a local level.**

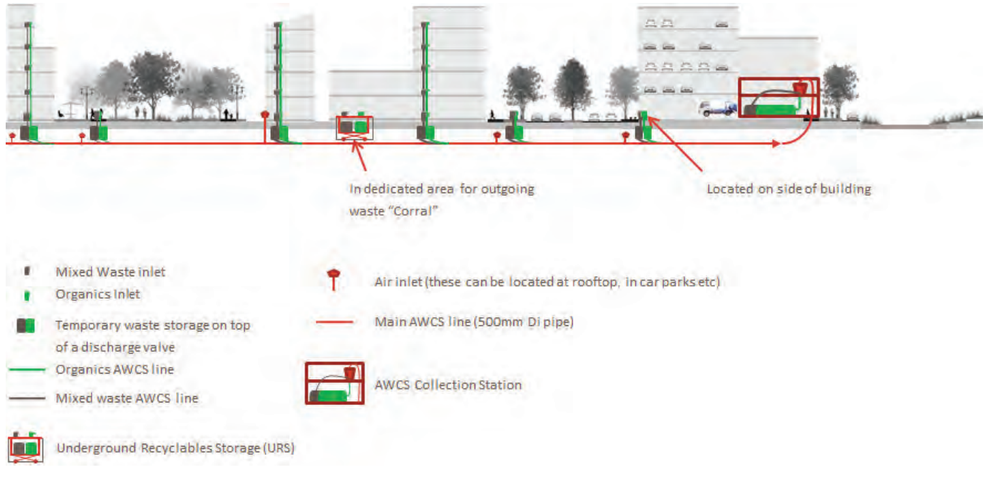
In the medium and long term, once the hub is consolidated it should aim to get a full AWCS in place for the project area if possible managed by the private sector.
The diagram below illustrates how this could be built in phases and integrated with other infrastructure elements.

The AWCS system would be built into the construction of the new buildings with inlets on each floor and an internal block pipe netwok that would have to be connected to the district pipe network. In the public space, inlets could be located on sidewalks and the park.

There is the option that the AWCS is only dedicated to food waste. It is a system that is cheaper than the full AWCS and helps to reduce odor and pest/vermin issues.
In order to fully develop the AWCS system there will be a requirement to locate a collection station within the CCD hub project area.

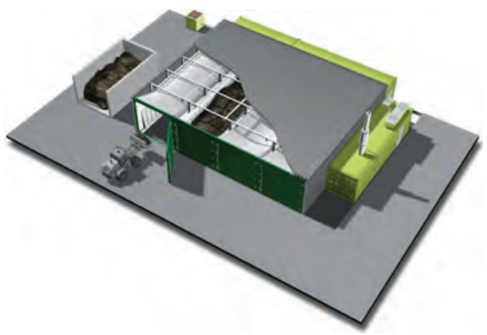
The general specifications of this buildings are sumarized below:
- Footprint = 4300 ft2 to 8600 ft2
- Capacity = up to 30 tons of waste per day.
- Typical floor to ceiling height is 29'

The central collection station comprises the following:
- Control room;
- Fans and compressed air generator;
- Cyclone separator;
- Waste compactor and containers;
- Filter room; and
- Storage room/WC.



ORGANIC TREATMENT & RECYCLING

The collection options presented will enable source separation of recyclables and organic waste. Recyclables should be stored on site, compacted if needed and then collected for recycling offsite.
Organics (food waste and landscape waste) could be treated on site via either Anaerobic Digestion or Aerobic Composting. This would greatly reduce (by about 65%) the disposal of waste at Landfill



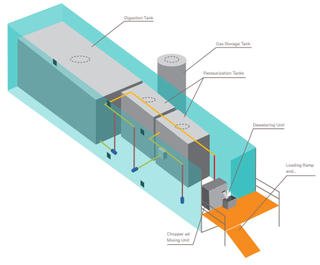
Parameter	IVC	AD
Waste water produced (kg/tons of BMW treated)	300	120
Biogas production (m^3/ton MSW) (60% CH^4, 38% CO_2, 2% Others)	0	110 - 170
Total carbon reduction (kg CO_2/ ton MSW input)	160	170
Electricity balance (kWh/ton MSW input)	- 50 to – 75 (- 73)	75 to 150 (+102)
Capital Costs For a 5,000tpa plant (Millions US$)	1.2	2.6
Operating costs (US$/tons of MSW input)	30-35	15-20

PLASMA TREATMENT & RECYCLING

Many Cities are now aiming to achieve zero waste disposal to landfill.
This is difficult to achieve without some form of thermal management system that can treat unrecyclable waste. Gasification or Plasma Gasification are potential technologies that can be used as part of an overall zero waste strategy.

Conversion of waste into syngas using a plasma arc lamp:
- Can operate on 2-200 tons/day
- Average area 0.1-0.2 m2/ton treated
- Waste volume reduction ~ 80%
- Positive energy surplus
- Currently an unproven and expensive technology
- Only viable if enough waste is available

It is not the purpose of this report to confirm the preferred long term recycling technology to be used in CCD. Yet it is important that the decision is made upon the understanding that CCD popullation alone won´t be enough to justify a capital investment of any of the above two technologies.



Diagramatic operation of small scale anerobic digestor

The key variables are:
- Resource Intensity
- Climate Intensity
- Resource Cost
- Mixes of Use
- Space Availability

Anaerobic Digestion
Between 15-500 tonnes/day

Gasification
Between 2-200 tonnes/day